LAUDA

Operating Instructions

LAUDA Compact Thermostats
C 6 CP, C 12 CP, C20 CP
K 6 KP, K 12 KP, K 20 KP
LAUDA Clear-View Thermostats
D 15 KP, D 20 KP, D 30 KP,
DL 15 KP, DL 20 KP

LAUDA Compact Thermostats
C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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1 Brief operating intructions

Even if you find these brief instructions initially sufficient please read the following sections, especially Section 4: "Safety devices and warning notes".
For safe operation of the equipment it is essential that the information in these Operating Instructions is observed.

Check the thermostat and the accessories during unpacking for any transport damage and if necessary inform the carrier or the postal authority.

Assemble the unit according to Section 6 and add extra items as appropriate.

1.1 Fitting the tubing to the pump connections:

Without external system: for improved circulation within the bath remove the closing plugs from both of the pump connections, fit the tubing nipples and link them together with e.g. Perbunan tubing (up to 120°C) or better a metal tubing.

For clear-view thermostats: for improved circulation within the bath close the pump connections with the closing plugs (see "Standard accessories", Item 6.1).

With external system: make tubing connections to the external system.

Protect the tubing with hose clips against slipping off.

When working near the ambient temperature connect up the external cooling according to Section 8.

Use only softened water or LAUDA bath liquids (Section 5). Fill up the bath to a level about 2 cm below the cover plate.

Check the supply voltage against the details on the label. Insert the mains plug.

Switch on the supply switch (green lamp lights up)

The display shows the software version and the type of unit, followed by the standard display.

Select the required indications using the keys ⬚ and ⬚ in the SHIFT mode. It is useful to show the setpoint (T_S) in display line 2 (L2) (see Items 9.3.1 - 9.3.3).

Set the overtemperature switch-off point (T_O) slightly above the operating temperature.

If there is an error message, press the key ⬚ and perhaps increase T_O.

Important: T_O must be at least 25 K below the fire point of the bath liquid used (see Item 9.3.4)!

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When connecting up an external system, check that filling this system does not cause the level inside the thermostat to fall more than is permitted.

When the thermostating liquid has reached the setpoint the symbol ⌀ starts to flash on the right in line 1 (L1) of the display.

After the unit has stabilised the bath temperature (T_i) corresponds to the setpoint (T_S).

1.2   *Operating safety*

The thermostat must be operated only with non-flammable bath liquids or with flammable bath liquids up to 25°C below their fire point, otherwise there is the possibility that a flammable atmosphere may form (see Item 4.2).

1.3   *Warning*

Parts of the bath cover may reach temperatures above 70°C when working at higher temperatures.The outflow and return pipes of the pumps reach the operating temperature. Touching them is dangerous because of very high or low temperatures!

2   **Technical Data** (to DIN 58966)

Type		C 6 CP	C 12 CP	C 20 CP	K 6 KP	K 12 KP	K 20 KP
Operating temperature range	(°C)	-30...300					
Working temperature range with water cooling (water 15°C)	(°C)	45...300	40...300	35...300	50...300	40...300	45...300
	(°C)	20...300 (≽ item 4.4.5)					
Ambient temperature range	(°C)	5...40	5...40	5...40	5...40	5...40	5...40
Temperature setting / Resolution		membrane keypad with 16 keys, setpoint input with 0.01°C resolution					
Bath temperature measurement		built-in digital thermometer with 0.01°C resolution; accuracy and stability of measurement (electronics without probe) better than 0.05% ± 0.05 K *). Temperature probe Pt 100 to DIN IEC 751, Class B, can be calibrated additively at each measurement point					
Display		back-lit LCD matrix display, 2 lines with 16 signs each, 10 mm character height					
External temperature measurement		2 separate temperature measurement circuits for external Pt 100 to DIN IEC 751 in 4-wire circuit, accuracy and stability of measurement better than 0.05% ± 0.05 K*), can be calibrated at each measurement point. One probe produces the measurement for external control					
Temperature control		modified PID controller with automatic structure selection. Control parameters through auto-adaptation or manual input with external control a cascade controller operates on the measurement of one of the two external circuits (T1 or T2).					
Temperature variation at 70°C in the bath	(°C)	0.01*)					
Heater power	(kW)	2	2	2	3	3	3
Effective surface area of cooling coil	(cm²)	350					
Safety system		Overtemperature protection with selctable switch off oint, low-level protection to EN 61010 FL (DIN 12879 Class 2)					
Pump output against zero head Pressure/Suction max. pump pressure	(L/min) (bar)	20/16 0.32/0.25	20/16 0.32/0.25	20/16 0.32/0.25	24/18 0.5/0.34	24/- 0.5/-	24/18 0.5/0.34
Pump connections	(I.W.)	M16x1; nipples 13 Ø					
Filling volume max.	(L)	4...6	9...14	14...21	4.5...7.5	6...12	11...18
Bath opening (B x T)	(mm)	150x130	300x175	300x350	150x130	150x130	300x175
Bath depth	(mm)	160	160	160	200	320	200
Usable liquid depth	(mm)	140	140	140	180	300	180
Height to top of bath	(mm)	220	220	220	260	380	260
Overall size (W x D x H)	(mm)	200x350x420	375x415x420	375x590x420	200x350x460	225x375x580	375x415x460
Weight	(Kg)	12	19	23	14	19	22
Supply	(V;Hz)	230;50 / 230;60 protection class 1 to VDE 0106					
Loading (max.) without accessories	(kW)	2.2	2.2	2.2	3.2	3.2	3.2
Current take up (max.) with accessories	(A)	15	15	15	16	16	16
Nominal current of fuses on customer's side	(A)	T 16 A					
		Units are conform to EU Guideline 89/336/EWG (EMC) and 73/23/EWG (low-voltage) and carry the CE mark (230 V; 50 Hz)					
Cat-No.:							
230V; 50Hz		**LCB 156**	**LCB 158**	**LCB 160**	**LCB 164**	**LCB 166**	**LCB 168**
230V; 60Hz		**LCB 256**	**LCB 258**	**LCB 260**	**LCB 264**	**LCB 266**	**LCB 268**

Units of different power supplies have different heating capacities as well as different values for power consumption (see type label)!

Technical changes reserved!

*) ≽ item 4.3

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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Type		D 15 KP	D 20 KP	D 30 KP	DL 15 KP	DL 20 KP
Operating temperature range	(°C)	0...230	0...230	0...230	-40...100	-40...100
Working temperature range with water cooling (water 15°C)	(°C)	45...230	40...230	40...230	45...100	45...100
	(°C)	20...300 (➢ item 4.4.5)	20...300 (➢ item 4.4.5)	20...300 (➢ item 4.4.5)	20...100 (➢ item 4.4.5)	20...100 (➢ item 4.4.5)
Ambient temperature range	(°C)	5...40	5...40	5...40	5...40	5...40
Temperature setting / Resolution		membrane keypad with 16 keys, setpoint input with 0.01°C resolution				
Bath temperature measurement		built-in digital thermometer with 0.01°C resolution; accuracy and stability of measurement (electronics without probe) better than 0.05% $\pm$ 0.05 K *). Temperature probe Pt 100 to DIN IEC 751, Class B, can be calibrated additively at each measurement point				
Display		back-lit LCD matrix display, 2 lines with 16 signs each, 10 mm character height				
External temperature measurement		2 separate temperature measurement circuits for external Pt 100 to DIN IEC 751 in 4-wire circuit, accuracy and stability of measurement better than 0.05% $\pm$ 0.05 K*), can be calibrated at each measurement point. One probe produces the measurement for external control				
Temperature control		modified PID controller with automatic structure selection. Control parameters through auto-adaptation or manual input with external control a cascade controller operates on the measurement of one of the two external circuits (T1 or T2).				
Temperature variation at 70°C in the bath	(°C)	0.01*)				
Heater power	(kW)	3	3	3	2	2
Effective surface area of cooling coil	(cm²)	350				
Safety system		Overtemperature protection with selctable switch off oint, low-level protection to EN 61010 FL (DIN 12879 Class 2)				
Pump output against zero head Pressure/Suction max. pump pressure	(L/min) (bar)	18 0.4	18 0.4	15 0.3	18 0.4	18 0.4
Pump connections	(I.W.)	M 16x1; Oliven 13Ø				
Filling volume max.	(L)	13...15	21...24	32...36	13...15	21...24
Bath opening (B x T)	(mm)	230x135	405x135	585x135	230x135	405x135
Bath depth	(mm)	320	320	320	320	320
Usable liquid depth	(mm)	265	265	265	265	265
Height to top of bath	(mm)	390	390	390	395	395
Overall size (W x D x H)	(mm)	480x225x590	710x235x590	1010x235x590	506x250x595	740x250x595
Weight	(Kg)	12	19	23	14	19
Supply	(V;Hz)	230;50 / 230;60 protection class 1 to VDE 0106				
Loading (max.) without accessories	(kW)	3.2	3.2	3.2	2.2	2.2
Current take up (max.) with accessories	(A)	16	16	16	16	16
Nominal current of fuses (max.) on customer's side	(A)	T 16 A				
		Units are conform to EU Guideline 89/336/EWG (EMC) and 73/23/EWG (low-voltage) and carry the CE mark (230 V; 50 Hz)				
Cat-No:						
230V; 50Hz		**LCD 121**	**LCD 122**	**LCD 123**	**LCD 1272**	**LCD 1273**
230V; 60Hz		**LCD 221**	**LCD 222**	**LCD 223**	**LCD 2272**	**LCD 2273**

Units of different power supplies have different heating capacities as well as different values for power consumption (see type label)!

Technical changes reserved!

*) ➢ item 4.3

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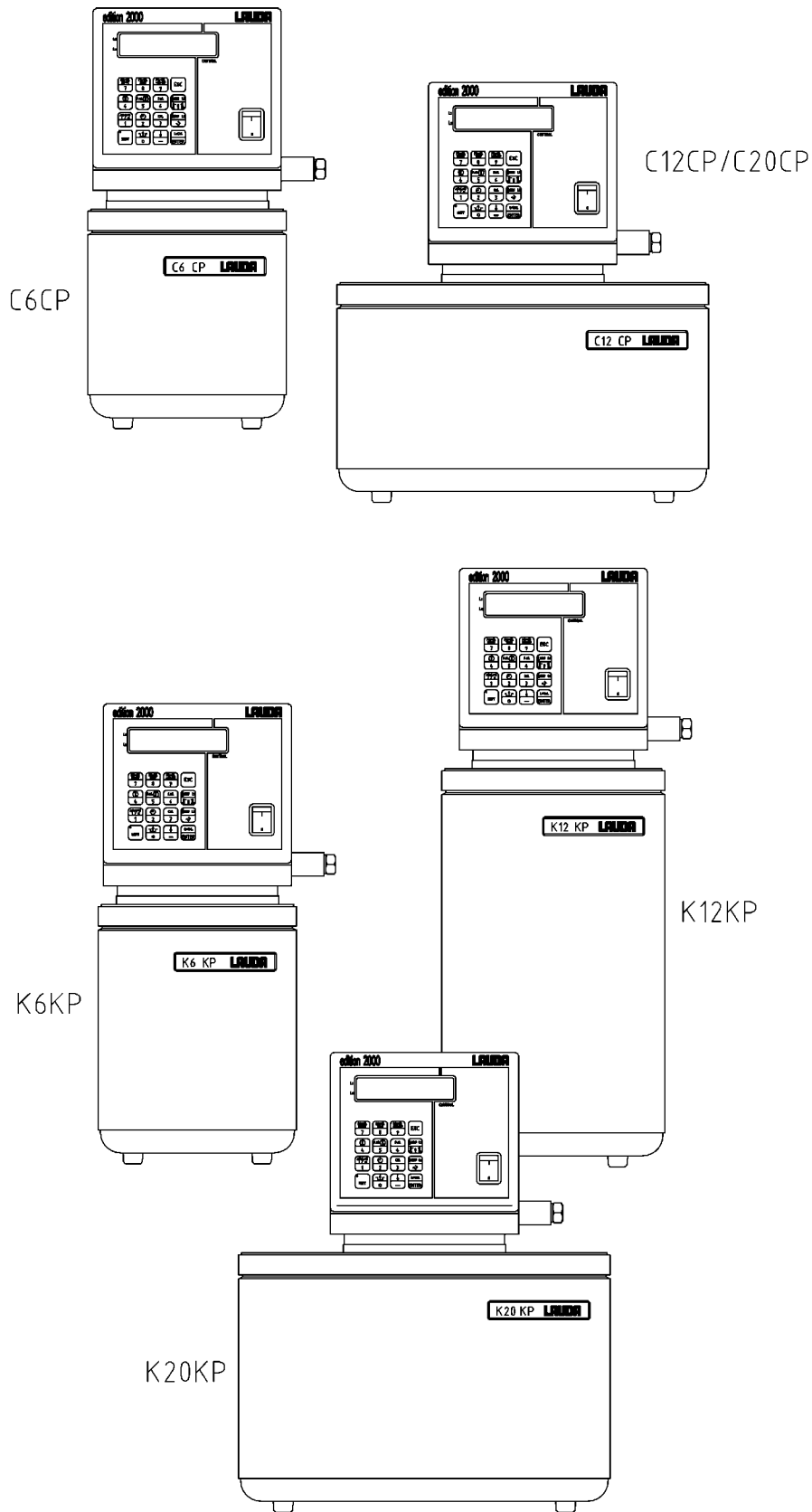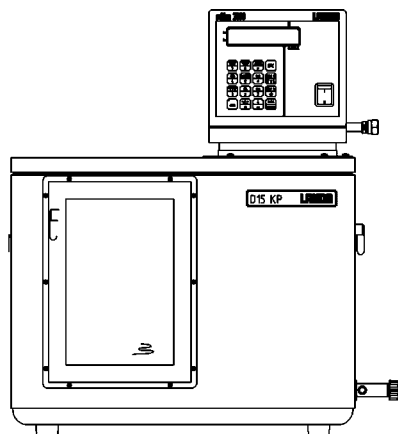
D15KP, DL15KP
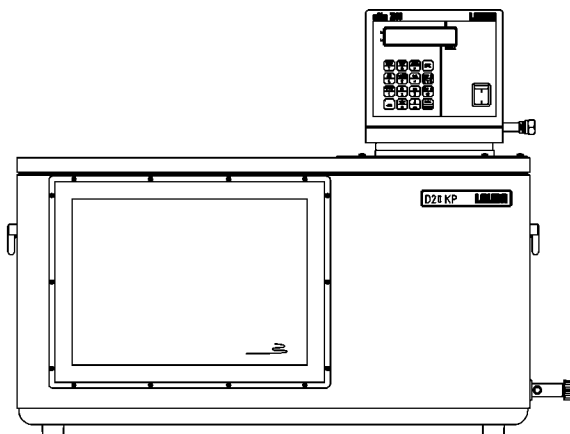
D20KP, DL20KP
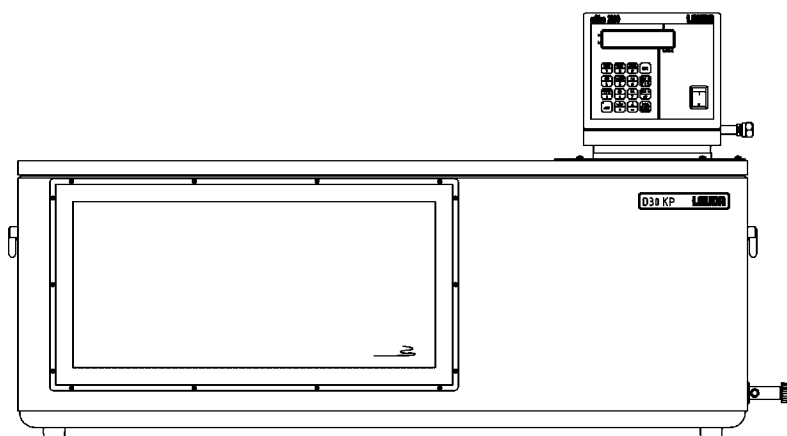
D30KP
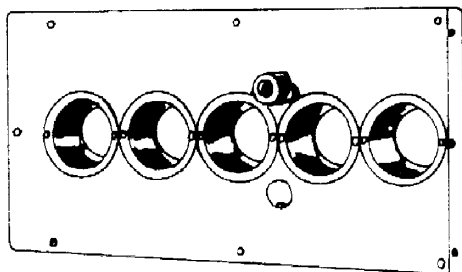
Deckplatte für Kapillarviskosimeter
Cover plate for capillary viscosimeter
Plaque support pour viscosimetres capillaires
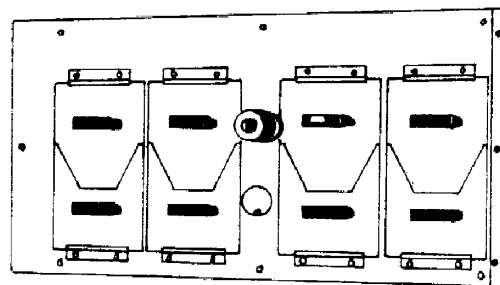
Deckplatte für VISCOTIMER-Messstative
Cover plate for VISCOTIMER measuring stands
Plaque support pour statifs de mesure du VISCOTIMER

Programmgeber
Programmer
Programmateur
9.9

Extern Regelung
Extern control
Régulation externe
9.7

Regelparameter
Control parameters
Paramètres de réglage
9.6

Analoge Ein-Ausgänge
Analogue inputs-outputs
Entrees-sorties analogique
9.11, 9.12

Schaltuhr
Timer
Horloge
9.15

edition 2000   LAUDA

L1 Ti =300.00 °C H
L2 Ts=300.00 °C Ti I

CONTROL

PROGR INPUT 7   PROGR TEST 8   PROGR ON/OFF 9   ESC
(i) 4   PAR (i) 5   PAR 6   DISP L1
ANALOG I/O 1   (clock) 2   CAL 3   DISP L2
SHIFT   0   —   LOCAL ENTER

I
0

Parameterebene
Parameter menue
Menu des paramètres
9.4

Übertemperatur
Overtemperature
Surtémperature
9.3.4

Displayumschaltung
Display selection
Sélection d'affichage
9.3.2

Sollwert
Setpoint
Valeur de consigne
9.3.6

Temperaturkalibrierung
Temperature Calibration
Calibrage témperature
9.5

Entsperren
Reset
Rèarmement
9.3.4, 9.13

Neutral Kontakt "Sammelstörung"
Neutral contact "Overall fault"
Contact neutre "Perturbation général"

Analoge Ein-Ausgänge
Analogue inputs-outputs
Entrées-sorties analogique

Anschluß f Magnetventil
Connection socket for
solenoid valve
Douille de branchement
pour l'électro vanne

Netzspannungsausgang
Mains supply output
Sortie tension secteur

Pumpenstutzen
Pump nozzles
Tubulures de pompe

Kontakteingang "Störung"
Input contact "Fault"
Entree "Perturbation"

Pt 100   T2

Pt 100   T1

RS 232 C

Kühlschlange
Cooling coil
Serpentin de réfroidissement

52S   12N   14N   Pt 100 T1   Pt 100 T2   10S
TEMP-SIGNAL   OUT   ALARM   IN
RS 232 C   53S
19H 230V~ max 8,2A
34H 230V~ CS max 4A KS max 2A
CE

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3 General construction and technical description

3.1 Operating principle

3.1.1 Bath/Circulation Thermostats

The LAUDA bath/circulation thermostats Series C and K with Electronics P differ in bath volume, bath depth, pump type and output as well as in heating capacity. All types offer an operating temperature range of -30...300°C. Laboratory thermostats operate with liquids (operating medium, heat transfer fluid) which serve for energy transfer to the product to be thermostated.

The thermostated products can be immersed in the thermostatic bath (bath thermostat), or placed in an external open bath whose liquid is circulated by the pump of the thermostat.

When operating as circulator the thermostatic liquid is pumped through an external heat exchanger arranged by the user in which a product is being thermostated (jacketed vessels, reactors, heat exchangers).

3.1.2 Clear-View Thermostats

The LAUDA clear-view thermostats Series D and DL with Electronics P differ in bath volume and temperature range. The units D...KP are equipped with double-walled inspection glasses and offer an operating temperature range of 0...230°C. The units DL...KP are equipped with four-fold insulating glasses for working in an operating temperature range of -40...100°C.

The units are especially suitable for thermostating capillary viscometers.

The bath is devided into a bath container which is supplied with inspection glasses of several layers at the front and the rear, and an ante-chamber, in which the function elements (heater, pump, cooling coil etc.) are located. This provides a constant bath level in the bath container.
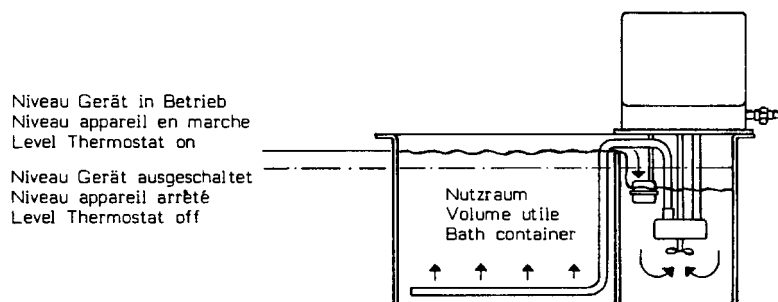
3.2 Materials

All materials in contact with the bath liquid are made from rust-free stainless steel or materials of similar anti-corrosion properties.

3.3 Cooling coil

All units are fitted with a cooling coil which permits cooling, e.g. with water, for working temperatures in the range of the ambient temperature (see Item 4.4.5 and Section 8).

3.4 Pumps

All units except Type K 12 KP and the clear-view thermostats are equipped with a centrifugal pressure/suction pump. This can be used to operate both external open baths as well as closed external systems (reactors).
The immersion pumps are supplied in the two performance classes C and K. The thermostat K 12 KP is fitted with a pure pressure pump since this unit operates specially in the high temperature range with closed external systems.
The pressure pumps of the clear-view thermostats ensure an excellent circulation using jet pipes and can also be used for external circulation if necessary.
The pumps are driven by external-runner motors with a continuous shaft.
The pumps operate perfectly up to a viscosity of approx. 70 mm^2/sec. (K 12 KP approx. 120 mm^2/sec.), with the pump output decreasing rapidly with increasing viscosity.

Pump characteristics
230V; 50Hz

——— C 6 CP, C 12 CP, C 20 CP
– – – K 6 KP, K 20 KP
–·— K 12 KP
–··— D 15 KP, D 20 KP, DL 15 KP, DL 20 KP
–––··– D 30 KP

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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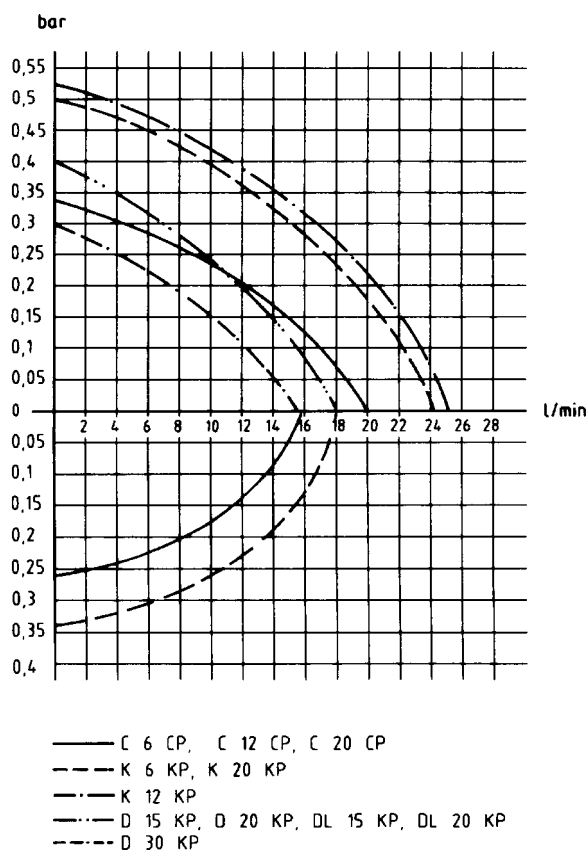
3.5 *Temperature control and electronics*

The units operate with a Pt 100 resistance thermometer for measuring the bath temperature (T_i). The bath temperature, all other temperature values and message signals as well as inputs are indicated as 2 x 16 characters (10 mm high) on a liquid crystal display (LCD) with background illumination. Input of the setpoint (T_S) and of all other parameters is made by using a membrane keypad with 16 keys and the operator guidance in the LCD display field. All inputs are stored even when the thermostat is switched off or if the supply fails.
The digitizing of the Pt 100 resistance signal is performed in the microprocessor by continuous comparison with precision resistors. The secondary control using a modified PID control algorithm is purely digital. The tubular heater for the heating of the bath is then operated electronically using a triac with burst firing action. The tubular heaters have a surface loading of approx. 6W/cm^2.

3.6 *Mains supply output 34 H*

The 230V supply voltage is available at the socket 34 H at the back in normal operation and with the unit switched on. The maximum current which can be drawn there is 4A on C-P units and 2A on K-P units. In case of a fault this supply is switched off. This output can be used e.g. to connect a through-flow chiller or a non-return fitting (Cat. No. UD 125).

Suitable mating plug   Cat. No. EQS 045

3.7 *Controlled cooling*

The units are equipped for controlled cooling to operate a solenoid valve which controls the cooling water flow. This provides fully automatic cooling (20...100°C). It ensures faster heating up (compared to continuous cooling), greatly reduced water consumption and improved temperature control during heat dissipation since the heater does not operate against the cooling action.

Solenoid valve for cooling water control   Cat. No. UD 085

3.8 *Remote operation (FBC) (option)*

As an option the units can be converted to remote control; then the entire electronics with control panel is removed from the unit and used for remote operation. An adapter for the cable connections is required on the basic unit and the control panel is placed in an extra housing. The conversion is to be carried out by a qualified electrician only. All necessary components except the connection cables are supplied as part of the kit.
Please specify the length of the connection cables. See accessories in the appendix.

4 Safety devices and warning notes

4.1 *Safety functions*

The built-in overtemperature limiter can be set over the complete operating temperature range.

The bath temperature is measured by a separate Pt 100 resistance sensor (T_{Si}) and processed by a separate analogue/digital converter. This measured value is compared with the measured value of the bath temperature probe (T_i) continuously. If the measurements differ by more than $\pm$15 K the thermostat switches off as in the case of a low-level or overtemperature fault.

The function of the microprocessor is monitored by an integrated watchdog circuit and an additional counter which operates similarly to a normal watchdog circuit but is also capable of switching off the unit in case of a strobe failure.

When the set overtemperature switch-off point (T_O) is exceeded the unit switches off permanently on all poles.

A float switch with magnetic coupling acts as a low-level cut-out and also switches off the unit (pump and heater) permanently on all poles.

In both fault conditions the display shows the corresponding message, and additionally an audible signal draws attention to the fault. The switch-off function of the safety circuit remains stored even during a break in the supply or after having switched off the supply.

Reset is possible by pressing the reset key ⎡↥⎤/⎣0⎦, but only after having eliminated the troubles.

The pump motor is fitted with a temperature monitor which switches off if the motor winding overheats. The heater is also switched off simultaneously. After the motor winding has cooled down the pump starts up automatically.

4.2 *Why can a thermostat be dangerous?*

1. Thermostats are equipped with heaters supplying the necessary heat to the thermostating liquid. If the temperature control fails or if the liquid level is too low, the heater may reach temperatures which can lead to a fire in the laboratory, especially in combination with flammable liquids.

2. When using the thermostat as a circulation thermostat a hose may break, causing hot liquid to spill and endangering people and goods.

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The safety requirements on thermostats therefore depend on whether

o   non-flammable or flammable liquids are used

o   operation is with or without supervision.

The thermostats described in these Operating Instructions are protected against overtemperature and low liquid level when operated according to the regulations (FL).

The units can be operated with non-flammable bath liquids and with flammable bath liquids up to 25°C below their fire point (EN 61010), on condition that there is a correct adjustment and regular testing (see Item 9.13) of overtemperature and low-level protection.

4.3   *Important notes*

The user is only protected against those hazards which are caused by exceeding the temperature and by low liquid level.

Further hazards may arise from the type of product being thermostated, e.g. a shift above or below certain temperature levels or a fracture of the container and a reaction with the thermostatic liquid etc.

It is impossible to cover all possible causes, and they remain largely within the decision and responsibility of the user.

Values for temperature variation and indication accuracy apply under normal conditions according to DIN 58966. In special cases high-frequency electromagnetic fields may lead to less favourable values. There is no loss of safety.

Units are in accordance with EMC directive EN 61 326-1, class A *:
Units are only suitable for use in industrial areas as disturbing voltage fluctuations might occur.

Note: The units must only be used according to the descriptions indicated in these Operating Instructions.

This includes operation by properly qualified and instructed personnel.
The units are not designed for operation under medical conditions according to
EN 60601-1 or IEC 601-1!

4.4   Warning notes

4.4.1   Temperatures

Parts of the bath cover may reach temperatures above 70°C when working at higher temperatures.The outflow and return pipes of the pumps reach the operating temperature. Touching them is dangerous because of very high or low temperatures!

4.4.2   Mains connection

Connect the unit only to mains sockets with protective earth contact (PE) which must not have a fuse higher than T 16 A!

4.4.3   Mains cable

We have ensured that the mains cable and other plug connections do not touch any hot parts. Please check that there is no contact between the connecting tubings filled with hot liquid or other hot parts and the mains cable!

4.4.4   Fume extraction

Depending on the bath liquid used and the operating method there is a possibility that toxic vapours may be produced. In that case it is necessary to provide an appropriate fume extraction. Pull out the mains plug before cleaning the bath with solvents. Provide appropriate fume extraction. Before starting up the unit it is absolutely essential to ensure that the bath contains no explosive mixture. If necessary purge it with nitrogen!

4.4.5   Cooling water, steam production

Use cooling coils with cooling water only at operating temperatures below 100°C; at higher temperatures there is a danger that superheated steam may be produced. When changing the bath liquid from water to heat transfer fluids for temperatures above 100°C any remaining water - including the one in the hoses and external system - has to be removed completely. Otherwise there is a danger of burns because of delayed boiling.

* Notice only valid for EU countries

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5 Bath liquids and hose connections

The operating temperature ranges of the bath liquids and hoses are for general information only and may be restricted through the operating temperature range of the units or the safety requirements specified in the appropriate standards (see Item 4.2).

5.1 Bath liquids

LAUDA Designation		Working-tem-perature-range	Chem. Designation	Visco-sity (kin)	Viscosity (kin) at temperature	Fire-point	Ref.No. Quantity		
	Former designation	from °C to °C	at 20°C	mm²/s	mm²/s		5 l	10 l	20 l
	Water	+5...+90	deionised water ①	--	--	--			
Kryo 30 ②	G 100 ②	-30...+90	Mono-ethylene-glycol/water	4	50 at -25°C	--	LZB 109	LZB 209	LZB 309
Kryo 85	Ultra-Therm XLT	-85...+30	Silicone oil	1.76	17 at -80°C	> 56	LZB 113	LZB 213	LZB 313
Ultra 350 ③	330 SCB	+30...+200	synthetic thermal oil	47	28 at +30°C	> 240	LZB 107	LZB 207	LZB 307
Ultra 300	Ultra-Therm SW 300N	+80...+300	Silicone oil	170	35 at +80°C	> 400	LZB 108	LZB 208	LZB 308
Therm 180	RDS 20	0...+180	Silicone oil	23	25 at 20°C	> 288	LZB 114	LZB 214	LZB 314
Therm 230	RDS 50	+60...+230	Silicone oil	54	28 at +60°C	> 362	LZB 117	LZB 217	LZB 317

☞
① At higher temperatures → Evaporation losses → Use bath covers (≽ Section 10. Accessories). Distilled water or fully deionised water must only be used with the addition of 0.1g sodium carbonate (Na_2CO_3) /l water, otherwise → danger of corrosion!

② Water content falls after prolonged operation at higher temperatures → mixture becomes flammable (flash point 128 °C). → Check the mixture ratio with a densitometer.

③ Do not use in conjunction with EPDM tubing!

– When selecting bath liquids it should be noted that performance must be expected to worsen at the lower limit of the operating temperature range due to increasing viscosity. The full operating range should only be utilised if really necessary.

– The operating ranges of the bath liquids and tubing represent general data which may be limited by the operating temperature range of the unit.

⚠ Silicone oil causes pronounced swelling of Silicone rubber → never use Silicone oil with Silicone tubing!

DIN Safety data sheets are available on request!

5.2 Hose connections

Tubing type	Int. dia. Ø mm	Temperature range °C	Application	Cat. No.
EPDM-tubing uninsulated	9	10...120	for all bath liquids except Ultra 350 and mineral oils	**RKJ 111**
EPDM-tubing insulated	9	-60...120	for all bath liquids except Ultra 350 and mineral oils	**LZS 019**
EPDM-tubing uninsulated	12	10...120	for all bath liquids except Ultra 350 and mineral oils	**RKJ 112**
EPDM-tubing insulated	12 ext. dia. 35mm approx	-60...120	for all bath liquids except Ultra 350 and mineral oils	**LZS 021**
Silicone tubing, uninsulated	11	-30...100	water, water/glycol mixture	**RKJ 059**
Silicone tubing, insulated	11 ext. dia. 35mm approx	-60...100	water, water/glycol mixture	**LZS 007**

⚠	− EPDM-tube <u>not</u> for Ultra 350 and mineral oils! − Silicone oil causes pronounced swelling of Silicone rubber → never use Silicone oil with Silicone tubing! − Protect tubing with hose clips against slipping off.

Metal hoses single-layer insulation	Tube connection	Ø i (mm)	Ø a (mm)	Temperature range °C	Length	Ref. No.
MC 50	M 16x1	10	18	-10...400	50	**LZM 040**
MC 100	M 16x1	10	18	-10...400	100	**LZM 041**
MC 150	M 16x1	10	18	-10...400	150	**LZM 042**
MC 200	M 16x1	10	18	-10...400	200	**LZM 043**
Pump link	M 16x1	10	18	-10...400	20	**LZM 044**

Metal hoses with triple insulation	Tube connection	Ø i (mm)	Ø a (mm)	Temperature range °C	Length	Ref. No.
MC 50 S	M 16x1	10	34	-60...350	50	**LZM 046**
MC 100 S	M 16x1	10	34	-60...350	100	**LZM 047**
MC 150 S	M 16x1	10	34	-60...350	150	**LZM 048**
MC 200 S	M 16x1	10	34	-60...350	200	**LZM 049**

Further details on thermostatic liquids and hoses can be found in our special publication.

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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6 Unpacking, assembly and setting up

6.1 Unpacking

Goods are packed carefully, largely preventing transport damage. If unexpectedly some damage is visible on the equipment please inform the carrier or the postal authority so that it can be inspected.

Standard accessories

|		
1 Bath cover	for C 6 CP. K 6 KP. K 12 KP	Cat. No. HDQ 069
1 Bath cover	for C 12 CP. K 20 KP	Cat. No. HDQ 067
2 Bath cover	forC 20 CP	Cat. No. HDQ 067 + HDQ 068
4 Nipples 13mm dia		Cat. No. HKO 026
4 Screw caps		Cat. No. HKM 032
2 Closing plugs		Cat. No. HKN 065
Operating Instructions		

6.2 Setting up, operation as bath thermostat

Set up the unit conveniently so that the control panel is towards the front, and ensure that the air circulation for the refrigeration system through the grille in the lower part of the unit and the ventilating openings at the back of the unit is not restricted. A minimum spacing of 20 cm between grille and wall is recommended.

Close the drain cock at the back or at the side of the bath!

When operating as bath thermostat - no external system connected up - it is advisable to ensure the internal circulation by removing the closing plugs from the pump flow and return connections. Remove the screw caps and link the pump connections together using a piece of hose. As a permanent arrangement the hose link of flexible insulated metal tubing (Cat. No. LZM 044) is the best and safest solution.
For clear-view thermostats: for improved circulation within the bath close the pump connections with the closing plugs.

Note: When loosening or tightening the screw caps (19 mm a/f), hold the threaded nipple on the tubing connections with a spanner (14 mm a/f)!

SW 14   SW 19
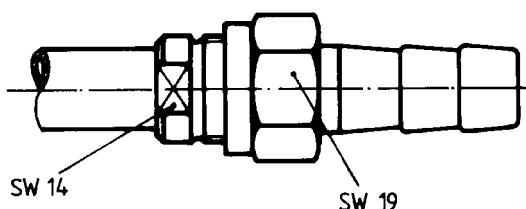
7   Connection of external systems

7.1   *Closed external circuits*

Remove the closing plugs by releasing the threaded rings (19 mm a/f) from the outflow and return connections and replace them by the tubing nipples (13 mm dia.) supplied. If the thermostat is connected to closed external circuits, additional liquid must be poured in after the thermostat has been switched on until the level in the bath remains at the correct height (approx. 2 cm below the cover plate).

At higher operating temperatures the expansion in volume of approx. 8% per 100°C during the filling must be taken into account.

For suitable tubing materials see Section 5. We recommend metal hoses for temperatures above 100°C.

With external systems at a higher level it may happen even in closed systems that the external volume drains down and the thermostat bath overflows if the pump is stopped and air enters the thermostated system!

Always ensure the maximum possible flow area in the external system (nipples, tubing, system). This results in a larger flow and therefore improved thermostatic control.

Note: Always protect the tubing with hose clips against slipping off, or use stainless steel hoses (V2A) with screwed connections.

7.2   *Open systems (baths)*

The units (except K 12 KP) are equipped with a pressure/suction pump. This can be used for the circulation of closed external circuits at higher pump outputs and in particular also of open external baths. There are two possibilities for maintaining the level in external baths:

1.   The suction tubing is mounted in the external bath so that its end is at the required liquid level. The flow of the pressure stage is restricted with a tubing clamp on the hose from the pressure connection to the external bath so that flow of the pressure stage is restricted slightly below that of the suction stage. This can be noticed when air enters the suction tubing.
This operating method is not recommended, in particular at temperatures below 0°C or when using oil at elevated temperatures.

2.   The preferred solution is the use of the LAUDA level controller (Cat. No. LPZ 901) which provides the functions of the adjustable level control with float, srew-on connection for external bath, and clamp fitting for 4 mm dia. Pt 100 probe.

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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7.2.1   Fitting the level controller

level controller   Cat. No. LPZ 901

Mount the level controller onto the external bath using the screw clamp ①. The mounting is suitable for both round and rectangular baths. Height adjustment after loosening the screw ②. Ensure a good circulation and the freedom of movement of the float!

Make the hose connections to the thermostat, connect the pressure nipple ④ to the pressure side and the suction nipple ⑤ to the suction side (see diagram).

Clamp fitting for Pt 100 probe (4 mm dia.) ③. The clamp ⑥ is not required on these units!
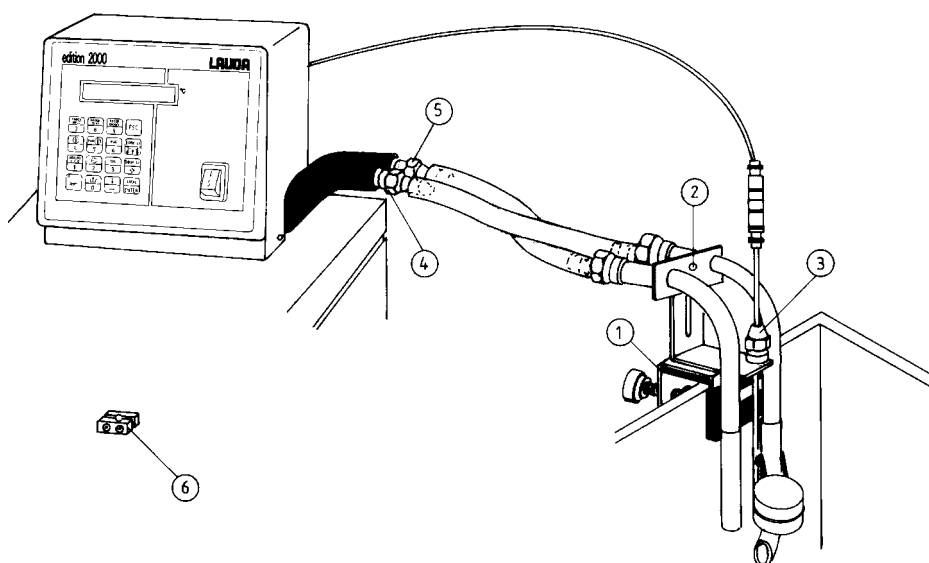
It is advisable to set up the external bath at the same level.

If the difference in level between the open external bath and the thermostat bath is greater than 0.5 m there is the possibility in certain applications that the control range of the level controller is not sufficient. At a higher (lower) external bath level the suction (pressure) hose should then be clamped off with a tubing clamp to such an extent that a constant level in the bath is obtained at which the float is within its control range.

Note: If the thermostat and the external bath are not at the same level it is essential to provide the venting of the connecting hoses when the pump is switched off in order to prevent overflowing.

It is preferable to use the Non-Return Fitting (see accessories) which is mounted at the highest point of the hose connection (bath or thermostat connection) and which is linked electrically to the mains output 34H.

Non-Return Fitting   Best-Nr. UD 125

Always protect the tubing with hose clips against slipping off, or use stainless steel hoses with screwed connections.

Note: When tightening the screw caps (19 mm a/f) at the tubing connections, hold the threaded nipple with a spanner (14 mm a/f)!

8   Cooling the thermostats

Because of the frictional heat of the circulating pump, thermostating without cooling can only start appreciably above the ambient temperature (see Technical data, working temperature range, lower limit). For lower temperatures it is essential to work with cooling. The following possibilities are available for cooling.

8.1   *Mains water cooling*

Depending on the water temperature down to 15°C. The thermostats are equipped with a cooling coil (at the rear) which is linked by tubing to the water tap and to the drain. The flow should be kept as low as possible; this saves water and improves the temperature control. Controlled cooling is possible when using a solenoid valve (see Item 3.7).

8.2   *Through-flow chillers DLK 10, DLK 25 and DLK 45*

They can be used, depending on the thermostat type, down to -10°C (DLK 10), -30°C (DLK 25) or -40°C (DLK 45). Use insulated hoses for the connection between the flow and return connections of the pump and the nipples of the through-flow chiller. If the thermostat operates in a closed external circuit the chiller is connected in series in the return line from the external system to the thermostat.

Always use water-glycol mixture (ratio 1:1).

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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9 Starting up

9.1 Filling

Fill the unit with bath liquid to suit the operating temperature, see Section 5. The filling volume is given under Technical data. In general the thermostat must be filled no higher than 2 cm below the cover plate. When working with thermal oils (e.g. Ultra-Therm 330 SCB) slightly less liquid should be filled in because of its expansion. The level must obviously not fall below the minimum, otherwise the low-level protection switches off the unit (see Safety circuit). The same applies to filling an external system by the pump during start-up.

<u>Clear-View Thermostats</u>

The unit has to be switched off and filled up to the filling marks for water or thermal oil. The mark for thermal oil, of course, only refers to the ambient temperature. When working at operating temperatures with the unit switched off the level for thermal oil can also reach the mark for water. When working with thermal oils slightly less liquid should be filled in because of its expansion. The level must obviously not fall below the minimum, otherwise the low-level protection switches off the unit (see Safety circuit). The same applies to filling an external system by the pump during start-up.

9.2 Connection to supply

Connect the unit only to an earthed socket (PE). Compare the details on the label with the mains voltage (see Item 4.4.2).

Model according to EMC directive EN 61326-1 (industrial areas only).*

When working <u>without</u> external system, ensure that the pump connections are linked together (metal hose link Cat. No. LZM 044) or closing plugs are being used.

9.3 Basic functions

9.3.1 Supply switch-on

Switch on the mains switch. The green indicating lamp lights up. The display shows consecutively

|	
Fa. LAUDA	
P-Thermostat	
Type C 6 CP	depending on type
V 2.XX Date	and software version
L_1 T_i = 20.00°C K	other values depending on
L_2 T_s= 10.00°C T_i I	bath temperature and setpoint

* Notice only valid for EU countries!

9.3.2 Standard display

Top line L1

T_i	=	bath temperature (i = internal)
C	=	output in cooling range
H	=	output in heating range

 = cooling indication proportional to cooling actuation control

 = heating indication proportional to heating actuation control

Bottom line L2

T_S	=	setpoint temperature (S = setpoint)
T_i	=	control variable is T_i (bath temperature), can be switched to T_1 or T_2 (ext. Pt 100).
I	=	setpoint source (I = internal = input from keys, P = programmer, R = from RS 232 C, A = analogue input socket 52 S)

The display in line 1 (L1) can be switched by pressing the keys [SHIFT] [DISP L1] and repeated operation of [DISP L1] to T_1, T_2, T_i etc.

T_1. T_2 = measurements of external Pt 100 probes

The display in line 2 (L2) can be switched by pressing the keys [SHIFT] [DISP L2] and repeated operation of [DISP L2] to

Y = actual output + heating - cooling

T_{SI} = measurement of safety comparison probe with limited resolution and accuracy

T_i. T_1. T_2. T_S etc..

9.3.3 Basic action on inputs and outputs

From virtually every display or input function the key [ESC] aborts and returns to the selected standard display!

Numerical inputs are always made with the SHIFT function switched off (LED in SHIFT

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key off)!

After the last digit of a number the cursor returns to the first digit again so that corrections can easily be made before pressing the ENTER (LOCAL) key.

A brief beep on pressing a key means that this input is not possible!
Error messages are indicated with text notes and accompanied by a beep. After approx.
5 sec the message disappears and the beep switches off!

9.3.4 Overtemperature switch-off point

Press the DISP L1 key to indicate the current overtemperature switch-off point (T$_O$).

Important: The green LED in the SHIFT key must not be alight. If necessary bring the keypad to the basic mode by pressing the SHIFT key (LED off). If T$_U$ is indicated, press DISP L1 again to indicate T$_O$.

$$L_2 \qquad T_O: \_ \ 95.00 \ T_i \ I$$

T_O = overtemperature switch-off point

T$_O$ can be selected within the unit temperature range + 5 K.

Return to the standard display without change with ESC. A new value is input with the number keys (SHIFT OFF); e.g. 98.70°C requires 0, 9, 8, 7, 0 ENTER (LOCAL). After the last digit the cursor returns to the first digit again so that any corrections can easily be made.

Pressing the key ENTER (LOCAL). Enter you are asked

$$L_2 \quad T_O \ neu \ Y/N \ 1/0\_\_(0)$$

Here the changed value must be confirmed with input 1 (ANALOG I/O) or, if no modification is requested, the initial value can be unscrambled again with input 0, 0. As default value 0 is preset.
This interrogation was introduced in order to reach an additional protection from unintentional adjusting of the over-temperature switch-off point.

It is obviously essential to select a value above the current bath temperature (T_i) and the current setpoint (T_S), otherwise the equipment is switched off by the safety circuit with

L_1 TEMPERATURE

L_2 TOO HIGH!

or the message

L_2 Ts   >>   To

and the value is not accepted.

With activated outflow temperature limit Tio To must always be 5°C higher than Tio. Otherwise announcement

Tio >> To –5°C.

If the unit was switched off in the fault status an audible signal reports the stored fault when switching on.

Press the reset key ⌐↑⌐ 0 Depending on the previous sequence press ⌐↑⌐ 0 again.

If necessary check whether the overtemperature switch-off point T_O is above the current bath temperature and whether the bath is filled sufficiently!

9.3.5   Low temperature switch-off point

Press the key (SHIFT OFF) to indicate the current low temperature switch-off point

T_U. If T_O is indicated press again to bring T_U on the display.

L_2 T_U: _ -10.00 °C

T_U = low temperature switch-off point

T_U can be set up to 10 K below the working temperature range of the unit.
If the bath temperature falls below T_U, T_U appears on the display in L_2 so that a new value can be input if necessary. T_U operates as a setpoint limitation and as a signal.

9.3.6   Setpoint input

Press the key (SHIFT LED OFF). L_2 shows

L_2 Ts:_   20.00°C T_i I

The setpoint (T_S) can be input within the unit temperature range but not higher than the current overtemperature switch-off point.

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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When the input is too high, pressing [ENTER (LOCAL)] does not enter the value but instead produces the message

$$L2 \quad Ts \quad >> \quad To$$

Input Ts with the number keys and the negative sign (SHIFT OFF), e.g. for -25.03°C input -, 2, 5, 0, 3 [ENTER (LOCAL)]. Or for 1.93°C input 0, 0, 1, 9, 3. [ENTER (LOCAL)]. After the last digit the cursor returns to the first digit again so that corrections can easily be made.

9.4 Parameter level PAR

Pressing the key [6 PAR] several times in the SHIFT mode (green LED in SHIFT key alight) leads successively to the input functions described below.

9.4.1 Auto-adaptation

Here it is possible to start the controller auto-adaptation by the input of 1 (SHIFT OFF) and pressing the [ENTER (LOCAL)] key.

There should be the largest possible difference between the bath temperature and the setpoint to be entered subsequently, i.e. the time to reach the setpoint has to be longer than 5 min, preferably 10 min. In addition, auto-adaptation is obviously possible only during a heating or cooling phase which is actively influenced by the energy sources available.

Example 1:   intended operating temperature approx. 70°C

    1.   set the setpoint to 70°C
    2.   within 1 minute start the auto-adaptation at the PAR level, e.g. at a bath temperature corresponding to the ambient temperature.

On reaching the setpoint the auto-adaptation switches off automatically, and the result of the auto-adaptation can be indicated at the control parameter level [5 PAR(i)] (see item 9.6).

Example 2:   it is required to operate at approx. 20°C with controlled cooling.

    1.   heat up the thermostat to approx. 60°C
    2.   set the setpoint to 20°C
    3.   start the auto-adaptation at the PAR level

9.4.2 Output limitation

Normally the maximum heating or cooling output is available. For special applications it is possible to set a limit for both heating and cooling output.

At the PAR level display select

L1   Output

L2   in per cent_ 100 %

Using [↓−] the display can be switched from e.g. 100%, i.e. heating output limitation, to cooling output limitation with a negative sign. SHIFT AUS. By the input of e.g. 0, 0, 5, 8 [LOCAL ENTER] SHIFT OFF, a heating output limitation of 58% can be set. With e.g. -, 0, 9, 3 [LOCAL ENTER] a cooling output limitation of 93% is entered. The action can be recognised by the symbols ⬊ and ⬊ flashing even at large control deviations.

Only values between 10 and 100% or -10 and -100% can be entered, otherwise the display shows the message

L1   Output

L2   OUT OF RANGE

9.4.3   Display resolution L1

At the PAR level display select

L1   Display 0.001 = 1

L2   resolution 0.01 = 0

Entering 1 (SHIFT OFF) [LOCAL ENTER] switches all displays in L1 to 0.001 K resolution. The temperatures are then displayed with approx. 2 digit resolution. Input "0" switches all the displays in L1 to 0.01 K resolution.
Normally a resolution of 0.01 K is used.

9.4.4   Contact input Fault 14 N

When using the contact input "FAULT" 14 N, pins 1 and 2 of the socket have to be connected together when there is no fault. If this input is not being used, a blanking plug with a link has to be plugged in. The function of the contact input fault can be switched off at the PAR level on the display

L1   Alarm Inp. con 14 N

L2   on = 1 off = 0

by the input of "0" (SHIFT OFF). A shorting plus is then not required.

If the alarm input has been activated in error by the input of "1", the unit can be restarted by the following inputs:

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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Press the key [⬆ 0] At the PAR level select "Alarm Inp. con 14 N". Input "0" with [LOCAL ENTER].

Press [⬆ 0] again.

If a fault message has been produced by opening the external signal circuit, reset by

pressing the key [⬆ 0] twice after rectifying the fault

Connections contact input "Fault" 14 N (alarm in)

3-pin flange socket to NAMUR recommendation NE 28

1 = n.o. (close)
2 = common
3 = not used

Connector plug 3-pin   Cat. No. EQS 048

Contact load approx. 5 V 2 mA. No voltage must be connected!

Use shielded connecting cables. Connect the shielding to the plug case. Cover the unused connectors with protective caps!

9.4.5   Baudrate RS 232

On the display at the PAR level

> L1   Ser. Int RS 232

> L2   Baud Rate 9600

it is possible to switch with [↓ −] between 9600 and 4800. With [LOCAL ENTER] (SHIFT OFF) the indicated baud rate is entered.

9.4.6   Menu language

On the display at the PAR level

> L1   Lang. Germ = 0

> L2   Engl. = 1   French. = 2

the menu language can be selected. Enter the corresponding code numbers 0, 1 or 2 with

[LOCAL ENTER] (SHIFT OFF).

9.4.7 Calibrating the analogue output channels

The 90% values of the analogue voltage outputs channel 1 and 2 or the analogue current output of channel 1 can be calibrated separately for channel 1 (voltage or current) and channel 2 (voltage). The factory calibration on channels 1 and 2 for 0...10 V = -100...400°C is performed at 9 V = 350°C.
In special cases, e.g. to correct scaling deviations of instruments connected to the output, or if channel 1 is to be a current output, the output can be calibrated by the user.

At the PAR level display select

> L1   Analogue outp. Cal ?

> L2   Chan 1 = 1   Chan 2 = 2

Input SHIFT OFF 1 $\boxed{\text{ENTER}}^{\text{LOCAL}}$, or 2 for channel 2..

Depending on the selected configuration of the analogue outputs (see Item 9.12) the socket 52 S (analogue signals, see Item 9.10) at pin 2 carries a voltage signal of approx. 95% or 9.5 V, or pin 5 the corresponding current signal of approx. 19 mA in case of current configuration for channel 1.

Using a precision multimeter or e.g. a temperature recorder set the output signal to 9 V or 18 mA or the corresponding temperature by the repeated operation of the key $\boxed{\downarrow\ -}$ (SHIFT ON).

Pressing $\boxed{\text{ESC}}$ leaves the menu and the most recent value setting is entered.

If the value was selected too low, leave the PAR level with $\boxed{\text{ESC}}$ and make a new selection.

The calibration of channel 2 is similar. Connect the measuring instrument to pin 1 (voltage signal only).

9.4.8 Operation with through-flow chiller DLK 45 with proportional cooling

At the PAR level display select

> L1   DLK normal   = 0

> L2   DLK auto   = 1

Select „DLK normal" by pressing 0 in order to have the function as already known of the two outputs 19 H and 34 H.

Select „DLK auto" by pressing 1 in order to operate a through-flow chiller DLK 45 with automatic compressor control and proportional cooling; see also operating instructions of the through-flow chillers.

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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9.5 *Calibration of the temperature measurement circuits*

With the calibration function the indications of the three temperature measuring points bath temperature T_i, external Pt 100 probe T_1 and external Pt 100 probe T_2 can be set to a known accurate value. The resulting correction is processed additively over the entire temperature range.

Check first that a sufficiently accurate reference is available, otherwise it is better to use the factory calibration which gets lost by overwriting!

Pressing the key [CAL 3] in the SHIFT mode (green LED in shift key alight) produces the display

> L1   CALIBRATE
>
> L2 $T_i = 0$ $T_1 = 1$ $T_2 = 2$

The channel to be calibrated is selected with 0, 1 or 2 [LOCAL ENTER].

When selecting an unused channel, e.g. if Pt 100 on T_2 is not connected, the display shows

> L1   Ext Pt 100 not
>
> L2   connected

For calibration a sufficiently accurate reference temperature measurement should be possible, and the measurement point temperature should be constant.

The display shows

> L1   T1   61.04°C
>
> L2 T_C _   .   °C

The value shown in L1 is the measured value obtained without any correction using probe and electronics without calibration. Now enter the real value for the measurement point T_1 (e.g. 60.00°C).

Example: 0. 6. 0. 0. 0 [LOCAL ENTER]

T_i or T_2 can be calibrated in the same way.
In order to avoid dangerous conditions the correction is limited to ± 5 K. In case of larger corrections the display shows

> L1   CORRECTION VALUE
>
> L2   TOO LARGE

and the entered value is not accepted.

You can leave the calibration level with [ESC].

9.6 *Control parameters*

9.6.1 Indication and input of the control parameters

Pressing the key $\boxed{\text{PAR}(\mathbf{i})\ 5}$ several times in the SHIFT mode (green LED in shift key alight) shows the outflow temperature limitation, the correction limitation and the control parameters X_p, T_n and T_v on the display in L2.

Example:

L2	T_{io}:	120°C	T_i	I
L2	T_d: _	30°C	T_i	I
L2	X_p: _	0.5°C	T_i	I
L2	T_n: _	12.0 s	T_i	I
L2	T_v: _	2.0 s	T_i	I

In order to use control parameters other than those found by auto-adaptation (see Item 9.4.1) the values can be entered in the appropriate display after switching off the SHIFT function, pressing $\boxed{\text{SHIFT}}$. LED off.

Example for X_P:

$$0.\ 0.\ 1.\ 0.\ \boxed{\text{LOCAL ENTER}}$$

if the required value is 1.0°C.

For values above 200.0°C or 200.0 sec the message

L2   OUT OF RANGE

Appears.

9.6.2 Recommendations for the control parameters

In most cases satisfactory control results are obtained with the following control parameters:

bath liquid	water	oil
X_P	0.5°C	1°C
T_n	10 s	25 s
T_v	2 s	5 s

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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9.6.3 Bath temperature limitation

The limitation of the bath temperature is an additional warning and switch-off function switching off the heating at a selectable value; i.e. the heating output is set to "0". This protects the unit from a continuous cut-off via the safety circuit especially during external control at certain operating conditions.

To enter the switch-off point T_{iO} proceed as described in Item 9.6.1, and switch the display to input and indication.

Example:

$$L_2 \qquad T_{iO} \qquad \underline{1}20 \,°C$$

Change the value by entering numerical inputs with a resolution of 1°C. Enter the new value by pressing ⌊LOCAL ENTER⌋.

It is possible to select values within a range from 50°C to the selected overtemperature switch-off point T_O -5°C. If this range has not been respected the display shows the message

$$L_2 \qquad T_{iO} >> T_O - 5 \,°C$$

Of course T_{iO} has to be set above the setpoint T_S; otherwise the display shows the message

$$L_2 \qquad T_S > T_{iO}$$

The bath temperature limitation can be switched off by entering

$$L_2 \qquad T_{iO} \qquad 000$$

If the bath temperature T_i exceeds the selected switch-off point the display shows

Example:

$$L_2 \qquad T_{iO} \qquad \underline{1}20 \,°C$$

and there is an acoustic signal. The heater switches off. As soon as the temperature has dropped the unit starts working again.

9.6.4 Correction limitation

During the operation with external control it may be necessary not to exceed the difference between the bath temperature T_i and the measuring point for the external control T_1 or T_2, e.g. in order to get a smooth heating of the material or the vessel.

Such a value can be selected by the variable T_d. If the value T_d is exceeded the heating or cooling output is set to "0". If this function is activated the times for heating up or cooling down may be extended".

To enter the difference value T_d, proceed as described in Item 9.6.1 and switch the display to input and indication.

Example:

$$L_2 \qquad T_d \qquad \_ \ 30°C$$

Change the value by entering numerical inputs with a resolution of 1°C.

Enter the new value by pressing $\boxed{\text{ENTER}}^{\text{LOCAL}}$.

It is possible to select values within the temperature range from 5°C to 150°C. If this range has not been respected the display shows

$$L_2 \qquad \text{OUT OF RANGE}$$

and there is an acoustic signal.

This function can be switched off by entering

$$L_2 \qquad T_d \qquad 000 \ °C$$

9.7   *External control*

9.7.1   **External measurement inputs and external controller**

The units have two Pt 100 temperature measurement inputs whose measurements can be indicated (T_1, T_2).

You can connect the external Pt 100 (T_1, T_2) at the rear connectors 10 S in 4-wire circuit.

Use shielded connecting cables. Connect the shielding to the plug case. Cover the unused connectors with protective caps!

Pin connections sockets 10 S Pt 100

pin

1	+	I	current path
2	+	U	voltage path
3	-	U	voltage path
4	-	I	current path

Pt 100
DIN IEC 751

Plug, 4-pin Lemosa, for Pt 100 connection   Cat. No. EQS 022

One probe can be selected for the actual value for external control. The unit then operates with cascade control to this actual value, i.e. the unit controls the temperature at the external measurement point to the selected setpoint by suitably altering the bath temperature. Thus the influence of disturbances (changes of load or through-flow, etc.) can be reduced considerably or eliminated totally.

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C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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9.7.2   Start of external control

Connect platinum resistance thermometers to both of the Pt 100 inputs 10 S (T_1 and T_2). It is sensible but not essential to use T_1 if only one input is in use.

The external control with the measuring point T_1 is switched on with the key [⏻ 4] in the SHIFT mode; pressing the key again switches to T_2 as control variable.

Pressing the key [⏻ 4] once more (SHIFT ON) switches back to the bath control (internal) T_i.

In L_2 the position before the final one shows the parameter used as control variable.

$$L_2 \qquad T_S \qquad = 120.35 \qquad \begin{matrix} T_i & I \\ T_1 & \\ T_2 & \end{matrix}$$

This setting remains stored in case of a fault or after the power is switched off.

If T_1 is selected but no probe has been connected the message

$$L_1 \qquad \text{Ext Pt 100 not}$$

$$L_2 \qquad \text{connected}$$

appears.

The unit then switches the control variable to T_2 automatically. If T_2 is also not connected, the thermostat switches to T_i.

When changing the setpoint for more than 10°C it may be possible to achieve an improved control result by restarting the external control from the control variable T_i (with SHIFT [⏻ 4]).

After power OFF the unit operates with control from the bath (T_i) for safety reasons; external control must be re-selected after power ON as explained above.

9.7.3   Notes

When operating with external control it is essential to ensure that the probe for the control variable is in good thermal contact with the liquid, otherwise a poor control result must be expected, or the control may be completely ineffective.
Proceeding from the control parameters used for bath control the control may have to be adapted either by auto-adaptation (see Item 9.4.1) or by the input of the control parameters.

Important: set the overtemperature switch-off point T_O (see Item 9.3.4) sufficiently high since the bath temperature may under certain circumstances become much higher than the setpoint.

9.8 *Working with controlled cooling*

Operation with controlled cooling requires a solenoid valve.

Insert the plug of the solenoid valve into the socket (19 H) on the back. The solenoid valve can be fitted either on the cooling coil or on a 1/2" water tap. Although fitting on the cooling coil is the usual method, mounting directly on the water tap is preferable for two reasons: When the valve is closed, the connection hose to the cooling coil is not under pressure; therefore there will not be a pressure surge when the valve is switched on, and the danger of the hose bursting is much reduced. Use hose clips!

With controlled cooling operation the solenoid valve switches with a cycle time of about 6 s. L_1 indicates on the right the symbol for the status of the solenoid valve. Restrict the water flow as much as possible at the water tap. This produces improved control and saves cooling water.

Note: Ensure that the cooling coil connections [🚰] are used. Do not mix them up with the pump connectors!

It is essential to ensure free outflow from the cooling coil, especially at operating temperatures above 100°C because of steam formation! The use of controlled cooling is particularly helpful when initiating exthermal reactions or in programmer operation.

Solenoid valve for cooling water control   Cat. No. UD 085

Mating plug for other solenoid valve   Cat. No. EQS 005

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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Mounting instructions for solenoid valve

Direct installation on the cooling coil (as supplied)

**Note!
Use hose clips!**

not
required

**Direct installation at the water tap
(modification)**   **is supplied separately**

sealed with
Teflon

sealed with Teflon

not required
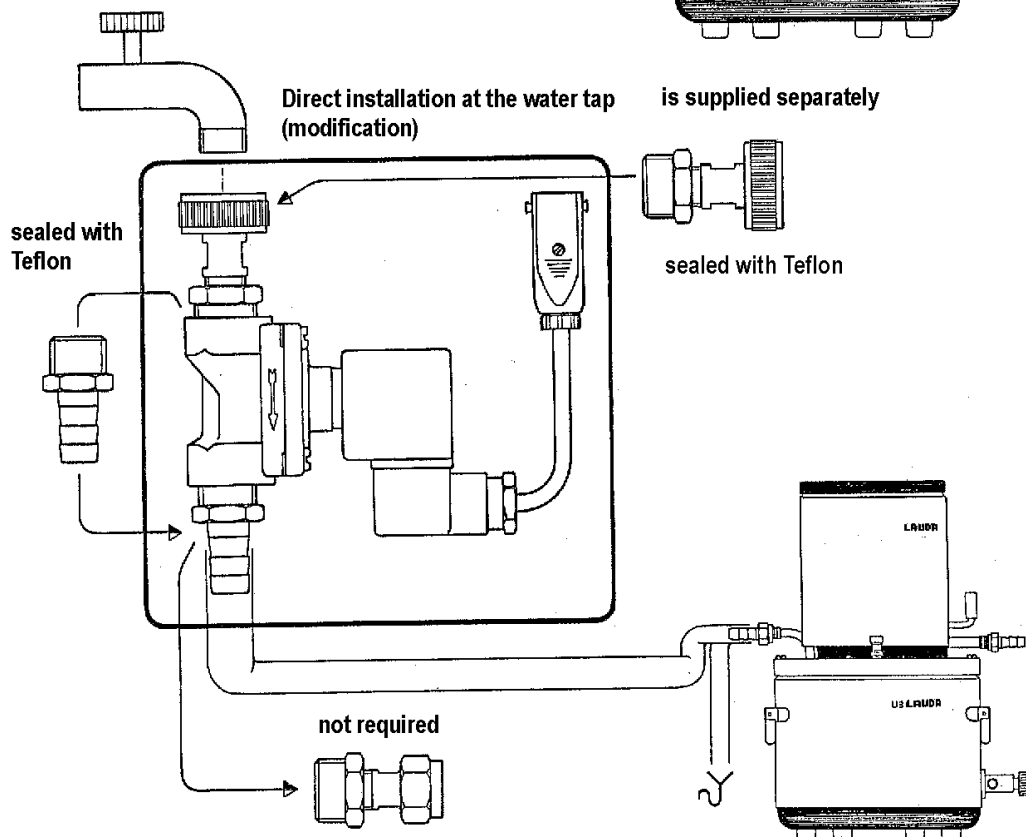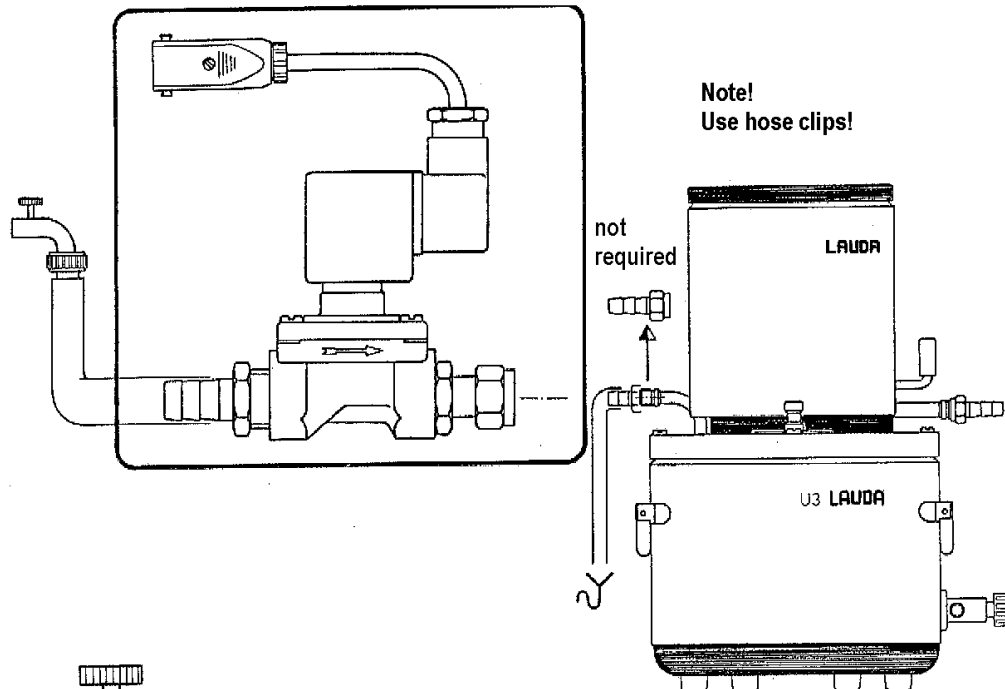
9.9 *Operation with programmer*

Temperature programmes with up to 99 segments can be stored and processed. A segment consists of a target temperature which is to be reached at the end of the segment, and the time duration of the segment. The time "00:00" for temperature differences is possible. In connection with the tolerance range monitoring the programme continues not until the target temperature is reached. It is useful to prepare a time-temperature diagram before programming and to check whether the energy balance enables the programme speed.

Set the overtemperature switch-off point T_O to a value slightly above the highest bath temperature to be expected (see Item 9.3.4).

9.9.1 **Programme input**

Press the key $\boxed{\begin{smallmatrix} PROGR \\ INPUT \\ 7 \end{smallmatrix}}$ in SHIFT mode. The display shows

> L1   PROG. INP
>
> L2   Tstart:_   .   °C

Enter here the starting temperature of the programme. SHIFT OFF (automatically), e.g.

for 60.00°C input 0,6,0,0,0 $\boxed{\begin{smallmatrix} LOCAL \\ ENTER \end{smallmatrix}}$

The display shows

> L1   PROG. INP SEG.01
>
> L2   T :_   .   °C   :   h

Now enter the target temperature and the time for the first segment, e.g. for 140.00°C in

the time 2 h 00 min 1, 4, 0, 0, 0 $\boxed{\begin{smallmatrix} LOCAL \\ ENTER \end{smallmatrix}}$ then 0,2 $\boxed{\begin{smallmatrix} LOCAL \\ ENTER \end{smallmatrix}}$ then 0, 0 $\boxed{\begin{smallmatrix} LOCAL \\ ENTER \end{smallmatrix}}$

The display shows

> L1   PROG. INP   SEG.02
>
> L2   T :_   .   °C   :   h

Now enter the target temperature and the time for the second segment, e.g. for a phase at a constant temperature 140.00°C and 1 h 30 min.

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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After the last programme segment press the key $\boxed{\substack{\text{LOCAL}\\\text{ENTER}}}$ once more.

The display shows

> L1   PROG. INP
>
> L2   NO OF CYCLES:_

Input 1 ... 99 is possible.

With more than one cycle it is convenient to have the final temperature and the starting temperature T_{start} at the same level!

Afterwards a tolerance range can be input for monitoring the programme.

The display shows

> L1   PROG. INP
>
> L2   TOL. RANGE _.

Now you can input a tolerance range value from 0.1 to 9.9°C. I.e. if the control variable (bath temperature or external temperature T_1 or T_2) deviates from the set temperature of the segment by more than the tolerance range value while the programme is running, the proramme sequence will be stopped until the control variable is within the tolerance range again. At the same time a "T" appears on the right in L2

The input of 0.0 switches off the tolerance range function.

9.9.2   Example of a programme
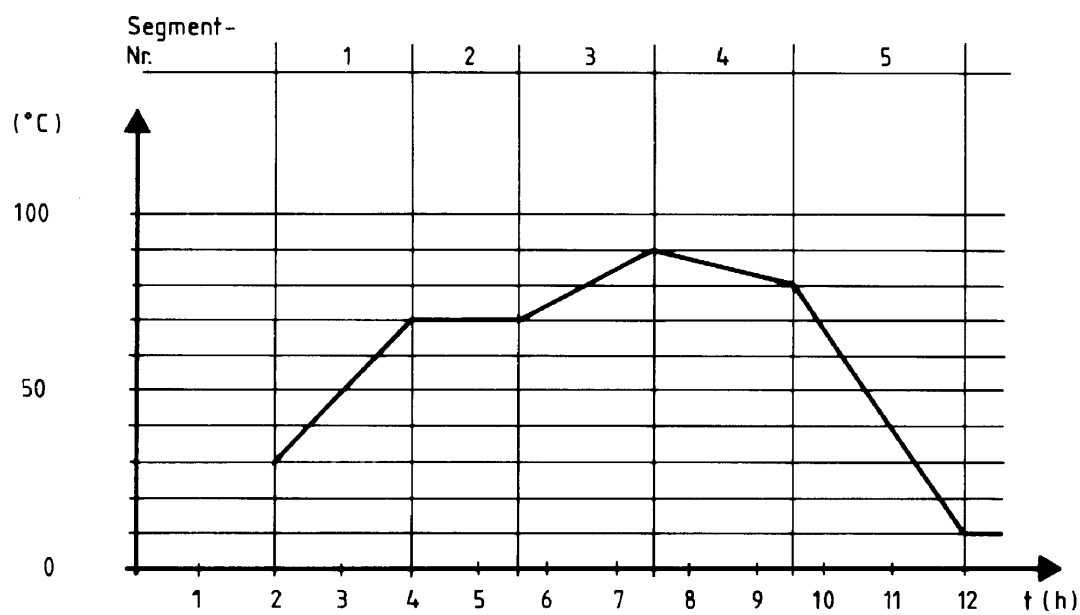
Segment-No.		Input	Press ENTER (LOCAL)
Tstart		03000	1x
1	°C	7000	1x
	h	02	1x
	min	00	1x
2	°C	7000	1x
	h	01	1x
	min	30	1x
3	°C	9000	1x
	h	02	1x
	min	00	1x
4	°C	8000	1x
	h	02	1x
	min	00	1x
5	°C	1000	1x
	h	02	1x
	min	30	2x
Cycles		1...99	1x
Tolerance range	±°C	(0.0) 0.1...9.9	1x

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C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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9.9.3   Programme test

After the input of the programme it is advisable to check that the programme buffer

contains the correct data. This is done with the key $\boxed{\begin{smallmatrix}\text{PROGR}\\\text{TEST}\\8\end{smallmatrix}}$ in the SHIFT mode.

Pressing the key repeatedly produces the same sequence as during the input of the programme.

9.9.4   Changing the programme data

Select the data line to be changed as in "programme test", SHIFT OFF. This resets the data of the indicated segment. Then the data can be input as usual. Enter the new data

with $\boxed{\begin{smallmatrix}\text{LOCAL}\\\text{ENTER}\end{smallmatrix}}$ each.

9.9.5   Programme start, interruption and abort

It is useful to bring the operating temperature of the thermostat to the programme start temperature T_{start} before starting the programme, or to automatize it by the tolerance range function.

Start the programme sequence with $\boxed{\begin{smallmatrix}\text{PROGR}\\\text{ON/OFF}\\9\end{smallmatrix}}$ in the SHIFT mode. The programme sequence can then be followed by the indication of the setpoint T_S.

L_1 shows on the right the segment number, and L_2 shows as a setpoint source a P for "programme" on the right.

The keys 1 to 9 are blocked while the programme is running.

The sequence of the programme can be stopped with SHIFT $\boxed{\begin{smallmatrix}\text{PROGR}\\\text{ON/OFF}\\9\end{smallmatrix}}$ and then be re-started

with SHIFT $\boxed{\begin{smallmatrix}\text{PROGR}\\\text{ON/OFF}\\9\end{smallmatrix}}$ During the interruption of the programme the display shows a W (wait)

on the right in L_2. The programme can be aborted with $\boxed{\text{ESC}}$ and then SHIFT $\boxed{\begin{smallmatrix}\text{PROGR}\\\text{ON/OFF}\\9\end{smallmatrix}}$ within 2 sec. Afterwards the programme can only be started with segment 1.

9.10   Connection for analogue signals socket 52 S

6-pin flange socket according to NAMUR recommendation NE 28.

Pin 1:	voltage output temperature signal channel 2: setpoint T_S, bath temperature T_i, external Pt 100 T_1 or T_2 can be selected. Scaling can be as follows: 0...10 V corresponding to a temperature range selected within the working temperature range (e.g. 50...80°C) minimum load 4 kOhm. or 0...6 V = -200...400°C = 10 mV/K 0°C = 2 V

or
0... 10 V = -100...400°C
or
0...10 V = 0...100°C

Pin 2: voltage output temperature signal channel 1, other data as pin 1

Pin 3: ground for all signals

Pin 4: setpoint voltage input; scaling can be selected as pin 1.
R_i = 12 kOhm approx.
(+ pin 4; - pin 3)

Pin 5: current output temperature signal channel 1; signal selection as pin 1. Can be configured for 0...20 mA or 4...20 mA. Scaling can be:

0...20/4...20 mA	=	-100...400°C
or		
0...20/4...20 mA	=	0...100°C
or		
0...20/4...20 mA	=	a temperature range selected within the working temperature range (e.g. 50...80°C)

maximum burden 330 Ohm.

Connect only either pin 2 or pin 5!!

Pin 6: setpoint current input; configuration and scaling as pin 5.
Burden 320 Ohm approx. Maximum voltage 15 V!

Connector plug, 6-pin   Cat. No. EQS 057

Use shielded connecting cables. Connect the shielding to the plug case. The mass for all signals (pin 3) must not be connected with ground! If a connection to the ground cannot be avoided use a potential-free signal bridge in between.
Cover the unused connectors with protective caps!

9.11 Analogue inputs

A setpoint in the form of an analogue current or voltage signal can be provided by connection to the socket "Temp.-Signal" 52 S (see Item 9.10).

- By pressing the key $\boxed{\substack{\text{ANALOG} \\ \text{I / O} \\ 1}}$ in the SHIFT mode the display shows

    L1   ANALOG INP/OUTP

    L2   INP = 0   OFF = 1_

Pressing 0 $\boxed{\substack{\text{LOCAL} \\ \text{ENTER}}}$ selects the configuration and scaling of a setpoint input.

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C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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The display shows

> L1   ANALOG INP. OFF = 0

> L2   ON = 1   CONF = 2_

- Input 1 ENTER switches in a previously configured input as setpoint, and L2 shows an "A" at the right end, indicating that the setpoint is determined by the analogue input.

This condition remains stored in case of a fault or after the power is switched off.

Input 0 ENTER switches the setpoint back to setpoint source I internal, i.e. key input.

Scaling takes place interactively by applying the voltage and current values corresponding to the appropriate temperature range limits to the corresponding input. For pin connections for voltage or current input on socket 52 S see Item 9.10. This method compensates various scaling errors, e.g. also those of the sources connected.

- Pressing 2 ENTER configures and scales the setpoint input. The display shows

> L1   ANALOG INPUT

> L2   U = 0 I = 1

Select a <u>voltage</u> range with 0 ENTER Voltages in the range 0...10.5 V can be handled.

A current range is selected with 1 ENTER Currents in the range 0...22 mA can be handled.

- The display shows

> L1   ANALOG INPUT

> L2   Tmin = _   .   °C

Input the lowest temperature of the range which corresponds to the lowest voltage or current value of the range to be scaled.

Example: range 0...120°C should correspond to 0...10 V approx.

Input 0, 0, 0, 0, 0 ENTER.

The display shows

L1   ANALOG INPUT

L2 $T_{max} = \_$.   °C

Input the upper limit of the temperature range 1, 2, 0, 0, 0 [LOCAL ENTER].

If the current input is selected, the programme asks whether 0...20 mA or 4...20 mA is required.

The display shows

L1   CURRENT INPUT

L2   0-20 = 0   4-20 = 1

Select 0 [LOCAL ENTER] or 1 [LOCAL ENTER] This menu item is omitted when the voltage input has been selected.

The display shows

L1   INPUT CAL.?

L2   YES = 1 NO = 0

Here the decision is made whether an automatic calibration procedure is started, or whether the voltage or current values from the last calibration procedure are retained with input 0 [LOCAL ENTER].

The display returns to the standard display. With a new calibration the voltage or current source (e.g. setpoint unit, programmer) must be connected up. The range limits must be adjustable.

The unit may switch to fault if the input signal is not connected. If this is the case it is necessary to connect the input signal first. Then press the reset key [0] and calibrate in the same way as described above.

Select recalibration with 1 [LOCAL ENTER].

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C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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The display shows

$$L_1 \qquad \text{SET } U_{min}$$

$$L_2 \qquad \text{YES} = 1$$

When the voltage or current corresponding to the <u>lower</u> range limit is applied to the input,

confirm this by input of 1 $\boxed{\substack{\text{LOCAL}\\ \text{ENTER}}}$.

The display shows

$$L_1 \qquad \text{-----wait-----}$$

$$L_2 \qquad \text{XXXXXXXXXXX}$$

The calibration takes approx. 20 sec. Then the display shows

$$L_1 \qquad \text{SET } U_{max}$$

$$L_2 \qquad \text{YES} = 1$$

When the voltage or current corresponding to the <u>upper</u> range limit is applied to the input,

confirm this by input of 1 $\boxed{\substack{\text{LOCAL}\\ \text{ENTER}}}$.

The display shows

$$L_1 \qquad \text{-----wait-----}$$

$$L_2 \qquad \text{XXXXXXXXXXX}$$

The calibration takes approx. 60 sec. Then the display returns to the standard display.
The calibration is finished.

- Switch-on the external setpoint from an analogue input as described in Item 9.11.2.

9.12   *Analogue outputs*

Two analogue output channels are available at the socket "Temp.-Signal" 52 S (see Item 9.10). They can be set to carry the temperature values

T_i =   bath temperature

T_1 =   temperature at ext. Pt 100 T_1

T_2 =   temperature at ext. Pt 100 T_2

T_S =   setpoint

9.12.1   Temperature signal channel 1

Channel 1 can be configured at socket 52 S on pin 2 as <u>voltage</u> output or on pin 5 as <u>current</u> output. Press key in SHIFT mode.

The display shows

L_1 ANALOG INP/OUTP

L_2 INP = 0 OUTP = 1

Select the processing of the outputs by pressing 1 ENTER. The display shows

L_1 Analog outputs

L_2 Chan 1=1 Chan 2=2

Select channel 1 by pressing 1 ENTER. The display shows

L_1 Analog output

L_2 U = 0   I = 1_

Select the current output with 1 ENTER. The display shows

L_1 CURRENT OUTPUT

L_2 0-20=0   4-20=1

Select the required current range 0...20 mA or 4...20 mA by pressing 0 or 1 ENTER

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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The current range selection is omitted if the voltage range 0...10 V has been selected in the previous menu. The display shows the scalings available for selection

> L1   CONFIGURABLE.=1
>
> L2   analog output _

By pressing the key [↓ −] (SHIFT ON) the pre-set scalings are displayed consecutively.

The selection is made by the input of the appropriate code (SHIFT OFF).

Configurable means that the temperature range required to correspond to the voltage range 0...10 V, current range 0...20 mA or 4...20 mA can be determined by setting the range start (T_{min}) and the range end (T_{max}).

The display shows

> L1   CONFIGURABLE.=1
>
> L2 T_{min}=_   .   °C

Example: Bereich 20...220°C

Input 0, 2, 0, 0, 0 [LOCAL ENTER]. The display shows

> L2 T_{max} =_   .   °C

Input 2, 2, 0, 0, 0 [LOCAL ENTER].

The following fixed scalings are available:

-200...400°C = 0...6 V = 10 mV/K

0°C = 2 V   Code 2

-100...400°C = 0...10 V oder 0...20 mA or 4...20 mA Code 3

0...100°C = 0...10 V oder 0...20 mA or 4..20 mA Code 4

The display then shows

> L2 T_i T_1 T_2 T_s 0-3_

E.g. to set the bath temperature on channel 1 input 0 [LOCAL ENTER].

Similarly for the temperature signal of the external Pt 100 T_1 input 1 [LOCAL ENTER] etc. The display then returns to the standard display.

9.12.2 Temperature signal channel 2

Channel 2 is purely a voltage output at socket 52 S on pin 1. The selection is made as described for channel 1 in Item 9.12.1 except that current ranges cannot be selected.

9.13 *Safety function*

The operation of the safety devices of the units has already been described under Item 4.1.

After starting up the user should confirm the correct operation of the safety devices. If the unit operates without supervision we recommend that this check should be carried out daily.

9.13.1 Low-level cut-out

For a correct operation of the low-level cut-out it is essential that the float switch operates correctly. To check this, lower the level in the bath by draining away some of the liquid. When the bath level falls below the minimum level (approx. 20 mm above the upper heater winding) the pump, the heating and the refrigeration unit switch off on all poles.

The display shows the message

L_1 LEVEL

L_2 TOO LOW

and there is a warning beep.

To restart fill up the bath and press the reset key ⬚ twice (with approx. 1 sec interval).

9.13.2 Adjustable overtemperature limiter

To check it the switch-off point T_O has to be set below the current bath temperature. Note that an input of T_O below the setpoint T_S produces the message.

L_2 T_S >> T_O

and the previous value for T_O is retained. Therefore the setpoint T_S usually has to be lowered first by a few degrees before carrying out this test. The overtemperature switch-off point can then be set e.g. 1 K below the current bath temperature.

Example: T_i =   60°C
              T_S =   60°C
              T_O =   65°C

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C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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To check the operation of the overtemperature limiter, press [DISP L1] (SHIFT OFF). Input

T_S = 20°C, press [DISP L2], the display shows

L1	TI	=	60.00°C C
L2	TO	:	65.00°C T_i I

If T_u is shown in L2, press [DISP L1] again!

Now input 0, 5, 8, 0, 0 [LOCAL ENTER].

The switch-off point of the overtemperature limiter is now 2 K below the bath temperature T_i. The display shows the message

L1	TEMPERATURE
L2	TOO HIGH!

with a beep. Heating and pump are switched off on all poles.

To restart the unit press the reset key [0]. The display shows the standard display.

Now press [DISP L1] and set T_O to a value above the bath temperature, e.g. 70°C:

Input 0, 7, 0, 0, 0 [LOCAL ENTER]. Then press the key [0] once more. The unit returns to normal operation.

Note: The overtemperature switch-off point has to be set at least 25 K below the fire point of the bath liquid used according to EN 61010.

In case of any malfunction in Items 9.13.1 and 9.13.2 the unit has to be taken out of use immediately and checked by an engineer, otherwise its safety is no longer ensured.

9.13.3   Connection potential-free contact "Combined fault" 12 N (Alarm off)

3-pin flange connector conforms to NAMUR recommendation NE 28

1 = n.o. (make)
2 = common
3 = n.c. (break)
1,2 are linked when unit operation is OK

Use shielded connecting cables. Connect the shielding to the plug case. Cover the unused connectors with protective caps!

Coupling socket 3-pin   Cat.No. EQD 047

9.14   Serial interface RS 232 C

-pin sub-D socket 53 S

9.14.1   Data of the RS 232 C interface

Cables used (computer end)

Computer			Thermostat	
25-pin		9-pin	9-pin	
3	R x D	2	2	T x D (Transmitted Data)
2	T x D	3	3	R x D (Received Data)
7	SG	5	5	Signal Ground
6	DSR	6	6	DTR (Data Terminal Ready)
4	RTS	7	7	CTS (Clear to send)
5	CTS	8	8	RTS (Request to send)

Use shielded connecting cables. Connect the shielding to the plug case. Cover the unused connectors with protective caps!

Using this interface it is possible to transfer the following data from or to a computer with a suitable interface:

1.   Transfer of the setpoint from the computer to the thermostat

2.   Read-out of the bath temperature T_i, the external temperature T_1, the external temperature T_2 and the setpoint on the unit

3.   Transfer of low temperature and overtemperature switch-off point

4.   Read-out of the set overtemperature and low temperature switch-off point

5.   Read-out of the fault signal

6.   Transfer of the ramp segments and their processing

7.   Status signal

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D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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8.   Read-out of the control parameter and transfer

9.   External controller status and start

9.14.2   General principles

The interface operates with two stop bits, no parity bit and with 8 data bits. The transfer rate can be set to 4800 baud or 9600 baud (see Item 9.4.6).

Values from the computer can be transferred directly to the thermostat, i.e. transmitted, e.g. OUT, SEG and START commands, or data can be transmitted from the thermostat to the computer on request with an IN command. An OUT, SEG or START command, if transmitted correctly, is always acknowledged by the thermostat with the message "OK" followed by LF and CR.

This message, like any other response, has to be requested by the computer!

Any output instruction (OUT, SEG, START, STOP) switches the thermostat to remote operation. This can be recognized by an R (setpoint source RS 232) on the right in L2.

Then all the keys are locked except for the functions "SHIFT [↓↑ DISP L1]" and "SHIFT [↳ DISP L2]" If there is no output instruction from the connected computer the keyboard can be activated until the next output instruction by pressing the keys [SHIFT] [LOCAL ENTER]. The data requests by the thermostat (IN commands) only lock the programme keys "SHIFT [7 PROGR INPUT]" and "SHIFT [8 PROGR TEST]" . [8 PROGR TEST]". All the other key functions are in operation. In the following text the symbol "_" will be taken to mean blank (no character).

RS 232 interface and controller are operated by a single processor; for optimum control it is therefore advisable to have pauses of at least 100 msec between the interface commands.

9.14.3   Output commands

OUT_XXX.XX   Setpoint transfer with up to 3 places before the decimal point and up to 3 places behind. This includes the negative sign. Transfer can take various forms, e.g. for 5.00°C: 005.00, 05, 05.0, 005, 5.00.

A BASIC programme for the IBM PC which can be used to transfer any values between the set upper limit (see Item 9.3.4) and which displays the response "O.K." or a possible error message, may be as follows:

Note: set baud rate to 4800 (see Item 9.4.5)!

```
10    OPEN  "COM1:4800,N,8,2"  AS #1
20    CLS
30    LOCATE 8,5:PRINT SPC(70)
40    LOCATE 8,5
50    INPUT "Enter your command (without OUT_)";VALUE$
60    PRINT #1;"OUT_"+VALUE$
70    INPUT #1;A$
80    LOCATE 12,5:PRINT SPC(50)
90    LOCATE 12,5:PRINT "Response of the thermostat";A$
100   TI = TIMER+1
110   IF TI > TIMER THEN 110
120   GOTO 30
130   END
```

The following values can be transmitted similarly to the thermostat:

OUT_LXXX.XX	switching point for low temperature (usually set to the lower range limit of the thermostat)
OUT_HXXX.XX	overtemperature switch-off point. For safety reasons it is essential that, after the transfer, this value is read back with the command IN_9 and checked!
OUT_XPXXX.XX	setting of the control parameter X_p for the controller
OUT_TNXXX.XX	setting of the control parameter T_n
OUT_TVXXX.XX	setting of the control parameter T_v
OUT_RT1	switches the control variable to the source external Pt 100 T_1 (external control)
OUT_RT2	switches the control variable to the source external Pt 100 T_2 (external control)
OUT_RTi	switches the control variable to the source T_i (probe in the bath); control according to the bath temperature
SEG_XXX.XX_XX:XX	using this programme segment command a segment can be written into the programmer buffer. It indicates the target temperature and the segment time hours (2 digits max.) and minutes (59 max.). The segment start is formed by the current setpoint, i.e. before the transfer of a programme segment it is useful to transfer a setpoint as a segment start suitable for the subsequent segment, using OUT_XXX.XX. "_" blank (no character).

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C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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SEG_(XX)_XXX_XX:XX	Single segment with segment number, used when whole temperature programmes are to be loaded from the computer to the thermostat. Thus, in contrast to the command SEG_, several segments may be transmitted. The programme starts with the latest setpoint; therefore please check before START whether the setpoint suitable for the first segment is available in the unit.
OUT_TBX.X	the tolerance range value is ½ of the value of the total range; i.e. 0.5 is 0.5 K; range 0.1...9.9 K. 0.0 switches off the tolerance range function.
OUT_CYXX	number of the programme cycles, range 1...99. 0 switches off the function, i.e. the programme is repeated until it is stopped manually.
START	starts the segment contained in the programme buffer
STOP	stops the programme segment run. With START the programme segment starts again from the beginning.

9.14.4   Requesting data from the thermostat

IN_1   indication of the bath temperature (T_i), i.e. the request
of the thermostat to transmit the bath temperature.

IN_2   indication of the temperature value at the external probe T_1

IN_3   indication of the current setpoint (T_S)

IN_4   status signal, 7 characters

char 1 from the left:	overtemperature fault = 1, no fault = 0
char 2:	low level fault = 1, level OK = 0
char 3:	programmer segment running = 1, programmer segment off = 0
char 4:	control according to the bath temperature (T_i) = 0, T_1 = 1, T_2 = 2
char 5:	setpoint set by analogue inputs = 1, analogue inputs off = 0
char 6:	indicates whether external Pt 100 T_1 is connected = 1, or not connected = 0
char 7:	indicates whether external Pt 100 T_2 is connected = 1, or not connected = 0

IN_5   invalid

IN_6   invalid

IN IN_7   indication of the temperature of the external probe T_2

IN_8   indication of the current low temperature switch-off point T_U

IN_9   indication of the current overtemperature switch-off point T_O

IN_A   indication of the current value of X_p

IN_B   indication of the current value of T_n

IN_C   indication of the current value of T_v

A BASIC programme used to transfer values from the thermostat to the computer and to display them specifying the channel number (e.g. 1 for IN_1, i.e. the bath temperature), is as follows:

Note: set baud rate to 4800 (see Item 9.4.5)!

```
10    OPEN "COM1:4800,N,8,2" AS #1
20    CLS
30    LOCATE 8,5:PRINT SPC(20)
40    LOCATE 8,5
50    INPUT "Channel No.";NO$
60    PRINT #1;"IN_"+NO$
70    INPUT #1;A$
80    LOCATE 12,5:PRINT SPC(50)
90    LOCATE 12,5:PRINT "Response of the thermostat";A$
100   TI = TIMER+1
110   IF TI > TIMER THEN 110
120   GOTO 30
130   END
```

The isolation of the status data may be as follows:

LEFT $ (A$,1)	=	overtemperature fault
MID $ (A$,2,1)	=	low-level fault
MID $ (A$,3,1)	=	programme segment running
MID $ (A$,4,1)	=	control by T_i, T_1 or T_2
MID $ (A$,5,1)	=	analogue input on/off
MID $ (A$,6,1)	=	external Pt 100 T_1 connected
RIGHT $ (A$,1)	=	external Pt 100 T_2 connected

LAUDA Compact Thermostats
C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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9.14.5 Error messages on the computer

The following error messages can be reported from the thermostat to the computer during operation:

ERR-2:   invalid inputs (e.g.: overflow of the input buffer)
ERR-3:   invalid command
ERR-5:   invalid command when switching the control variable
         for the controller, e.g. external controller
         OUT_RT2. Other command than OUT_RTI, OUT_RT1,
         OUT_RT2.
ERR-6:   temperature value cannot be set
ERR-7:   syntax error in channel number
ERR-8:   channel does not exist

9.15   Timing clock function

The unit is equipped with a clock indicating day, month, year, weekday, hours and minutes and provides these for the timing function.

The clock is backed for approx. 10 years by a built-in battery so that the clock continues to operate even when the unit is not connected to the electrical supply.

9.15.1 Setting and indication of date and time

This function is only required when changing from summer to winter time and vice versa, or when the unit is being operated in other time zones. Date and time are set at the factory when the unit is started up for the first time.

By pressing the key [⏱ 2] in the SHIFT mode the display shows

L_1 clock = 0   activ = 1

L_2 SET = 2   FUNCT = 3

By the input of 0 [LOCAL ENTER] date and time are indicated. [ESC] returns to the standard display.

The input of 2 [LOCAL ENTER] (SET) allows date and time to be altered. The display shows:

L_1 DA MO YE   H MI

L_2 _ . .   :

Day, month, year, weekday, hours and minutes are now input in sequence.

Weekday code.

1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday
7	Sunday

The hours are input from 0 to 24 (factory-set to Central European Time).

Example: L2   19.01.94 3 16:05

Terminate the input with $\boxed{\text{LOCAL}\atop\text{ENTER}}$.

9.15.2   Timing clock function

By pressing the key $\boxed{\text{⌚}\atop 2}$ in SHIFT mode the display shows the menu as described in Item 9.15.1. Select the timing function FUNCT = 3 with 3 $\boxed{\text{LOCAL}\atop\text{ENTER}}$.

The display shows

L1   Thermostat ON = 1

L2   OR OFF = 0

Here it can be selected whether the thermostat should automatically switch on or off at the time to be selected subsequently in Item 9.15.3. Input either 1 or 0 as appropriate. A display to input date and time appears.

Input here the switching point for the timing function as described in Item 9.15.1 and enter it with $\boxed{\text{LOCAL}\atop\text{ENTER}}$. The display returns to the standard display.

9.15.3   Activating the timing clock function

By pressing the key $\boxed{\text{⌚}\atop 2}$ in SHIFT mode the display shows the selection menu as described in Item 9.15.1. Activate the timing function with ACTIV = 1 by the input of 1 $\boxed{\text{LOCAL}\atop\text{ENTER}}$. Again the display shows

L1   Clock

L2   ON = 1 OFF = 0

LAUDA Compact Thermostats
C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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Normally 1 [LOCAL ENTER] is input here to activate the timing function.

The timing clock symbol now appears in line L1 before the last position. If the previous selection was that the thermostat should switch on automatically, the thermostat now switches off and starts up at the selected time.

When the unit has been switched off through the timing function, the display shows

L2   CLOCK STOP!

The activated timing function can always be switched off with off = 0, i.e. with 0 [LOCAL ENTER]. In addition the timing function can be cancelled at any time with [ESC].

10   Maintenance

10.1   *Safety notes in case of repairs*

Always pull out the mains plug for all repair and cleaning operations! Repairs on the
control unit with the cover removed must only be carried out by a qualified electrician.

10.2   *Repair and re-initilisation*

LAUDA thermostats are largely free from maintenance. Dirty thermostatic liquid should be
removed through the drain cock and replaced. If the unit should become faulty it may be
advisable to return only the faulty module where appropriate.

The control unit can easily be removed after removing the cover, releasing 2 screws ①
(2 turns) behind the front panel and disconnecting the electrical connections ②.
The module with pump, heater, temperature probe etc. can also be separated from the
bath easily.
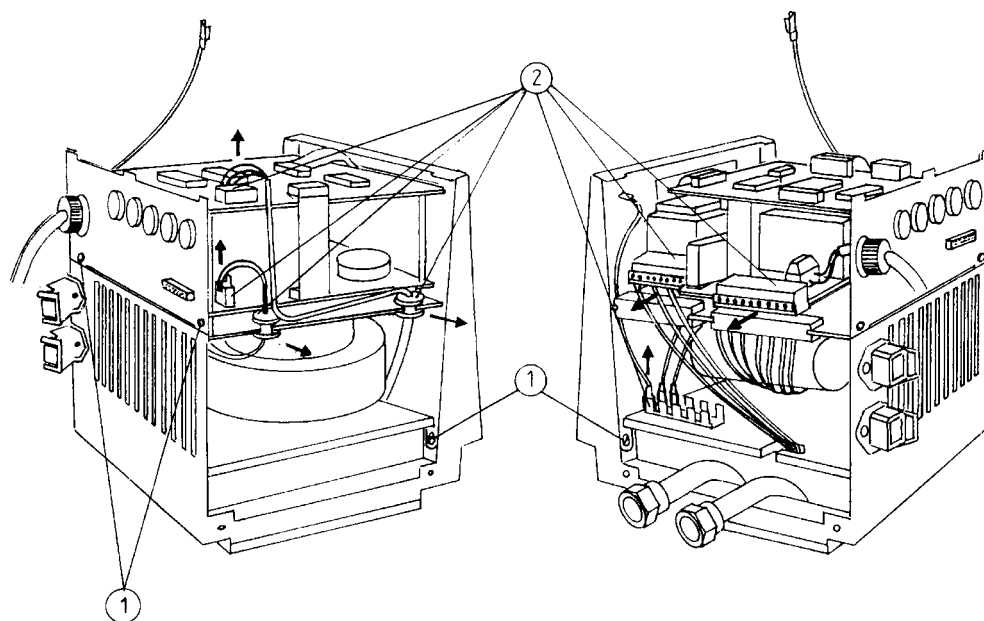
When replacing the control unit, check whether the new control unit has been
programmed for the correct basic unit type. If the correct type does not appear after
having switched on the mains switch, proceed as follows:

Mains switch off, press the keys [SHIFT] and [PAR 6] simultaneously and at the same time
switch on the supply.

Wait until the following display appears:

   L1   RK 20 K = 0   K 12 K = 1

   L2   Type

LAUDA Compact Thermostats
C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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Release the keys ⌷SHIFT⌷ and ⌷PAR 6⌷ and go through the menu with the key ⌷↓ −⌷ until the

required type appears. Input the code number and enter with ⌷LOCAL ENTER⌷.

The type designations are shown abbreviated, e.g. C 6 C instead of C 6 CP.

There is no provision for a fuse for the complete unit since the necessary 16A fuse corresponds to the mains fuse usually provided at the location. The control circuit of the unit has a separate fuse; a fuse 5 x 20 F4A is located in the control unit. This is accessible after removing the cover. When the fuse has blown the green lamp in the mains switch does not light up.

10.3   *Cleaning*

The unit can be cleaned using a cloth moistened with water with the addition of a few drops of (domestic) detergent. No water must find its way into the control unit.
The user is responsible for any necessary decontamination if dangerous materials have been spilled on or inside the unit. This applies in particular if the unit is removed for a different use, for repair, storage etc.

The method of cleaning or decontamination is determined by the expertise of the user himself. If the user has any doubts on whether this may damage the unit he has to contact the manufacturer.

10.4   *Spares ordering*

When ordering spares please specify the equipment type and number on the label. This avoids queries and prevents the supply of wrong goods!

We shall always be happy to deal with queries, suggestions and complaints.

**LAUDA DR. R. WOBSER
GMBH & CO. KG
Postfach 1251
97912 Lauda-Königshofen
Phone: (+49) (0) 9343/ 503-0
Fax: (+49) (0) 9343/ 503-222
E-mail info @ lauda.de
Internet http://www.lauda.de**

11 Accessories

LAUDA Compact Temperature Thermostats C-P and K-P

<u>LAUDA through-flow chillers</u>
For cooling thermostats, in particular at operating temperatures
below the working temperature range.

DLK 10	Cat. No. LFD 105
DLK 25	Cat. No. LFD 106
DLK 45	Cat. No. LFD 107

<u>Racks</u> in stainless steel
for test tubes, centrifuge tubes etc.

Bath C 12 up to 2 racks
Bath C 20 up to 4 racks

RD 13	for 56 tubes 10 - 13 dia., 80 mm immersion	Cat. No UG 066
RD 18/1	for 33 tubes 14 - 18 dia., 80 mm immersion	Cat. No UG 067
RD 18/2	for 33 tubes 14 - 18 dia., 110 mm immersion	Cat. No. UG 068
RD 30	for 14 tubes 24 - 30 dia., 110 mm immersion	Cat. No. UG 069

Bath K 20 up to 2 racks

RE 13	for 56 tubes 10 - 13 dia., 80 mm immersion	Cat. No. UG 070
RE 18/1	for 33 tubes 14 - 18 dia., 80 mm immersion	Cat. No. UG 071
RE 18/2	for 33 tubes 14 - 18 dia., 110 mm immersion	Cat. No. UG 072
RE 30	for 14 tubes 24 - 30 dia., 110 mm immersion	Cat. No. UG 073

Bath C 6 1 rack

RF 18/1	for 20 tubes 14 - 18 dia., 80 mm immersion	Cat. No. UG 074
RF 18/2	for 20 tubes 14 - 18 dia., 110 mm immersion	Cat. No. UG 075

Bath K 6 1 rack

RG 18/1	for 20 tubes 14 - 18 dia., 80 mm immersion	Cat. No. UG 076
RK 18/2	for 20 tubes 14 - 18 dia., 110 mm immersion	Cat. No. UG 077

Details of other racks on request

<u>Rising platform</u> for retrofitting	Cat. No. LCZ 012

size 250x160 mm, with continuous height adjustment
suitable for:

Bath C 12 (1 platform)
Bath C 20 (2 platforms)
Bath K 20 (1 platform

<u>Gable cover</u>, stainless steel for C 20	Cat. No. LCZ 011
<u>Level controller</u>	Cat. No. LPZ 901

for thermostating an open external bath
using pressure/suction pump

<u>Non-return fitting</u>	Cat. No. UD 125

for automatic venting of the connecting hoses
when thermostating an open external bath

LAUDA Compact Thermostats
C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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Cover plates for clear-view thermostats

UD 15 K for 3 manual measuring stands	D 15 KP/ DL 15 KP	Cat. No. LTZ 017
UD 20 K for 5 manual measuring stands	D 20 KP/ DL 20 KP	Cat. No. LTZ 019
UD 30 K for 9 manual measuring stands	D 30 KP	Cat. No. LTZ 021
UD 15 V for 2 automatic measuring stands	D 15 KP/ DL 15 KP	Cat. No. LTZ 018
UD 20 V for 4 automatic measuring stands	D 20 KP/ DL 20 KP	Cat. No. LTZ 020
UD 30 V for 6 automatic measuring stands	D 30 KP	Cat. No. LTZ 022
UD 15 V/K for 2 manual measuring stands and 1 automatic measuring stand	D 15 KP/ DL 15 KP	Cat. No. LTZ 030
UD 20 V/K for 3 manual measuring stands and 3 automatic measuring stand	D 20 KP/ DL 20 KP	Cat. No. LTZ 031

Cover plates made of plastic, particularly for low temperatures

UDL 15 K for 3 manual measuring stands	DL 15 KP	Cat. No. LTZ 041
UDL 15 V for 2 automatic measuring stands	DL 15 KP	Cat. No. LTZ 042
UDL 20 K for 5 manual measuring stands	DL 20 KP	Cat. No. LTZ 043
UDL 20 V for 4 automatic measuring stands	DL 20 KP	Cat. No. LTZ 044

Atherman illuminators AL

special large-area non-dazzling illuminators
free from thermal radiation

AL 15	D 15 KP/ DL 15 KP	Cat. No. LTZ 001
AL 20	D 20 KP/ DL 20 KP	Cat. No. LTZ 002
AL 30	D 30 KP	Cat. No. LTZ 003

Remote operation FBC	Cat. No. LCZ 960
without cable set	
The electronic control unit is placed separately	
from the unit and linked to it by cable.	
Cable set for FBC length 5 m	Cat. No. UK 235
Cable set for FBC length as specified	Cat. No. UK 238

Nipples
for pump connections

13 mm dia., 10 mm int. dia.	Cat. No. HKO 026
11 mm dia., 7 mm int. dia.	Cat. No. HKO 025

LAUDA Pt 100 platinum resistance thermometers
to DIN IEC 751 Class A for external control
and other temperature measurement

Pt 100-42   Cat. No. ETP 049
all-glass version with NS 14/23 ground taper DIN 12242
Temp. range -100...300°C
50% response time 0.8 sec
Overall length approx. 115 mm
4-wire circuit
Fig. 1

Pt 100-44   Cat. No. ETP 007
all-glass version with NS 14/23 ground taper DIN 12242
Temp. range -100...300°C
50% response time 0.8 sec
Overall length approx. 320mm
Fig. 2

Pt 100-66   Cat. No. ETP 008
as Pt 100-44
Overall length approx. 430mm
Fig. 2

Pt 100-90   Cat. No. ETP 050
stainless steel protection tube 4 mm dia.
Temp. range -100...300°C
50% response time 1.5 sec
Overall length approx. 120 mm
4-wire circuit
Fig. 3

Pt 100-70   Cat. No. ETP 009
stainless steel protection tube 4 mm dia.
Temp. range -200...300°C
50% response time 1.5 sec
Overall length approx. 290 mm
4-wire circuit
Fig. 3

LAUDA Compact Thermostats
C 6 CP, C 12 CP, C 20 CP, K 6 KP, K 12 KP, K 20 KP,
D 15 KP, D 20 KP, D 30 KP, DL 15 KP, DL 20 KP

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Pt 100-92   Cat. No. ETP 051
stainless steel protection tube 4 mm dia.
with attached Silicone cable 2 m long and plug
Temp. range -100...200°C
50% response time 3 sec
Overall length approx. 250 mm
4-wire circuit
Fig. 4

Connecting cable
with 4-pin plug for external control on
all C-and K-units and for digital thermometer
for Pt 100-44 and Pt 100-66
Length 1.5m   Cat. No. UK 048
Length as specified   Cat. No. UK 213

for Pt 100-42. Pt 100-70. Pt 100-90
Length 1.5m   Cat. No. UK 047
Length as specified   Cat. No. UK 212

Screw clamp fitting   Cat. No. HX 078
stainless steel, with Teflon pressure ring
for Pt 100 resistance thermometer 4 mm dia.
Fig. 5

Fig. 1

Fig. 2

Fig. 3

Fig. 4

75

30

4,5

Pt 100-42

NS 14/29
DIN 122 42

A

B

4,5

	A	B
Pt 100-44	300	135
Pt 100-66	410	245

A

4

	A
Pt 100-90	80
Pt 100-70	250

210

4

SW 14

32

8

Ø4

M8 × 1

Fig. 5

A4

A5

Ti 100,00 °C

Ts 100,00 °C

A3

A2

A1

Anschlußbelegung

53 S
RS 232

x30 Netzspannung	100V	230V
100V	X	
115V	X	
230V		X

x31,x32	AC	DC
CxP,KxP	X	
DxP,DLxP	X	
RCxP,RKxP	X	
RLxP,RUL80		X
RUKxx		X
R400P	X	
R403PL,R406PL	X	

R403PL
R406PL

H1

12N
Alarm
OUT

14N
Alarm
IN

825
Analog
Ein/Ausgang
Ausgang Kanal 2
Ausgang Kanal 1
GND
0-10V Eingang
1-Ausgang
0-24mA Eingang

RCxP
100-115V/60Hz

RCxP

RKxP

Anschlussbelegung
EXTERN
PT 100
S18
EXTERN
PT 100
S18
Ventilator M3
Anlaufrelais
Klixon Kompressor
M2
start
run
C2
C3
K11
x23/1
x23/8

Sicherheits-
kreis
PT 100
Istwert
PT 100
x24

Niveauanzeige
x28

Niveausensor
x25

KTY
x26

Druckschalter
F2
F7
Klixon Kompressor
M2
M3
C3
x22/1
x23/8

Y1
x23/4
x23/3

SSM
x27
Heizung
Pumpe
M1
C1
E1
Rücklauf-sicherung bei CxP/KxP/DxP
Ansteuerung KM bei CxP/RKxP/RKxP
x9
x22

Kühlen
Achtung!!!
Jumper x31-x32
auf RC stellen
x8

A6
x20
B5
Ventilator M3
Klixon Kompressor
M2

Netzschalter
S1
x21

Netzstecker
x1

Y1
x23/4
x23/3

Y2

Drossel
Y2

Kühlen
Sicherung
C2 start
Startrelais K31
C3 run
Druckschalter

ab Serie X01001 (UYI22 ab Version 2.14)

LAUDA
Dr. R. Wobser GmbH & Co KG

Schaltplan
Schéma de connexions
Circuit diagram

CxP/KxP/DxP/DLxP/RCxP/RKxP
Blatt 2
8 Bl.

Datum 14.03.1996
Bearb. B.Scheissl
B.Sm.Datum
Name Gepr.

a | Zus1.Änderung | Tgs
08/187 | 18.12.98 | Tgs

Für diese Zeichnung behalten wir uns alle nicht ausdrücklich eingeräumten Nutzungsrechte
einschließlich der Vervielfältigung und Weitergabe an Dritte vor. Technische Änderungen vorbehalten

Geräteliste Schaltplan   **C 6 CP**   **gültig ab Serie X01**
List of parts Circuit diagram   **C 12 CP**   **at serial no.**
Liste de schéma connexions   **C 20 CP**   **à partir**
230V; 50Hz

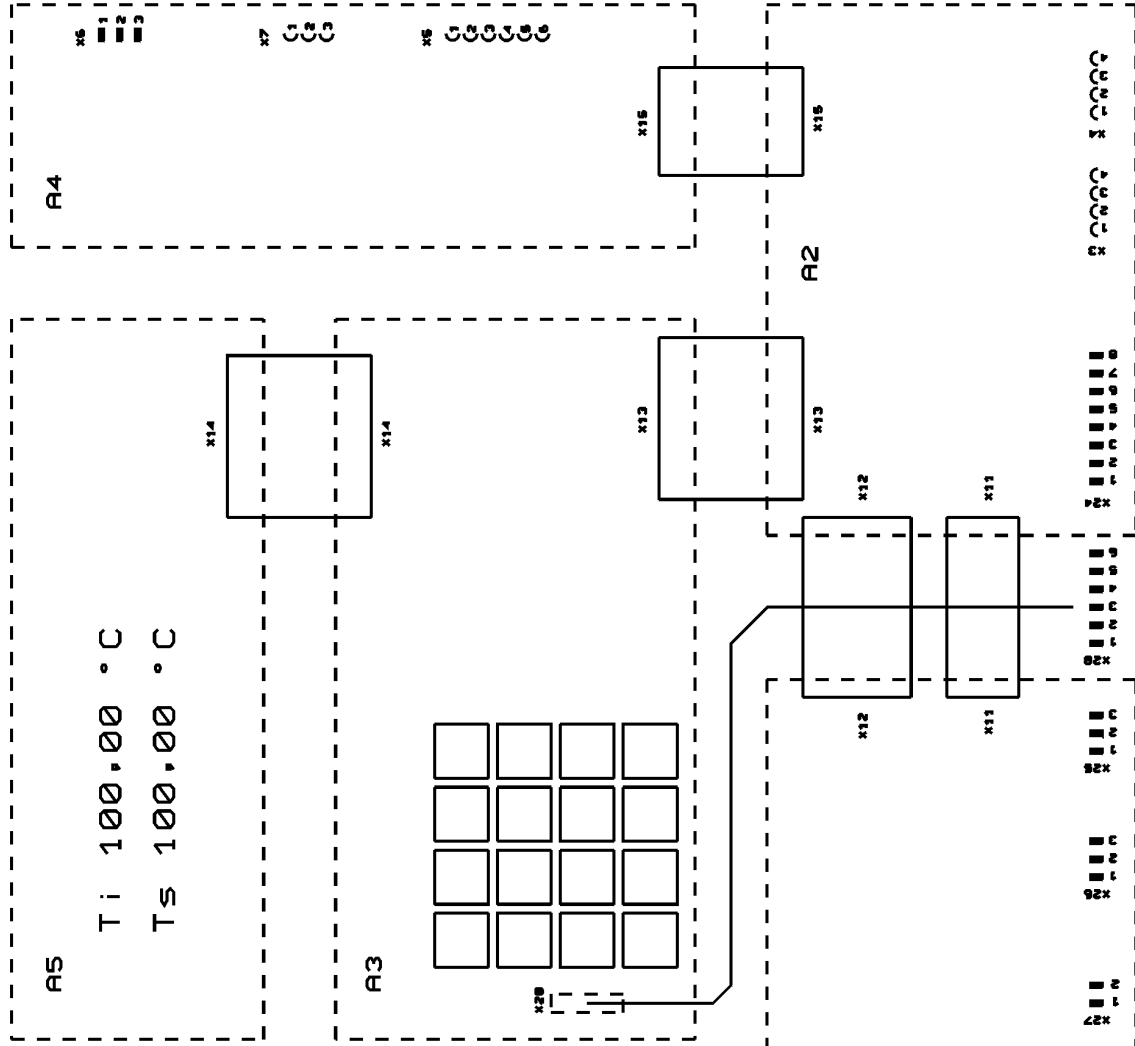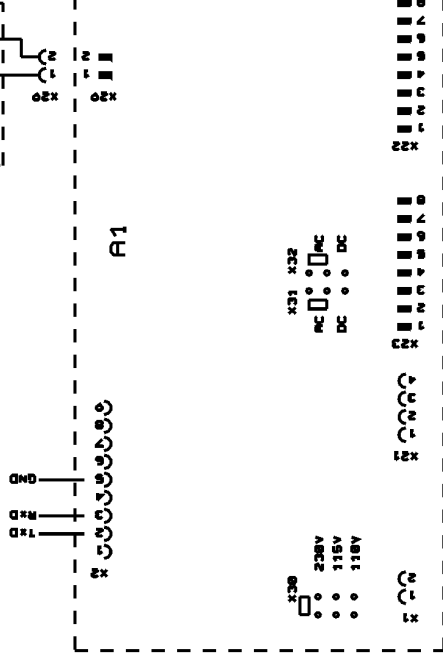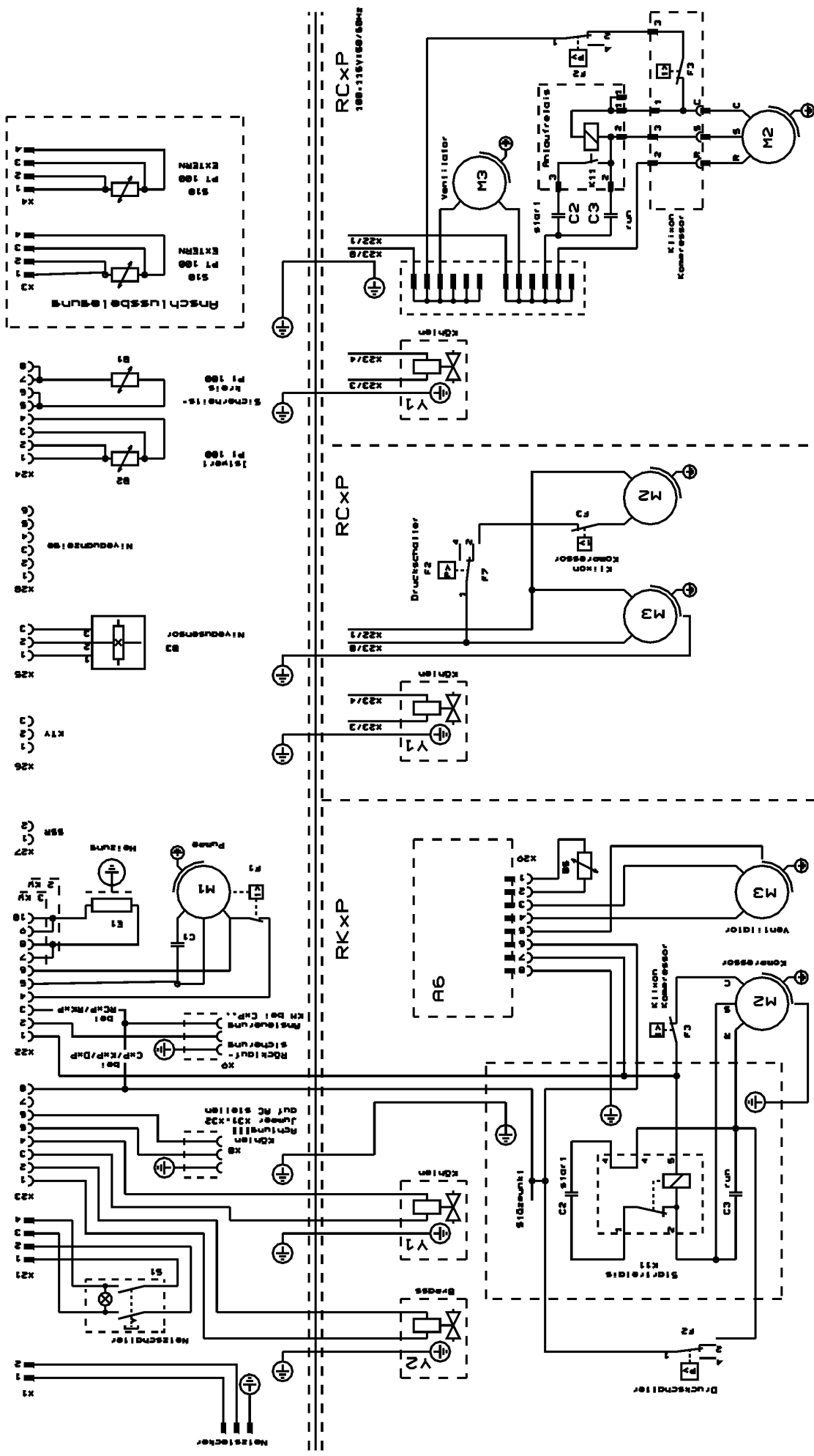| Teil-Nr. Part No. Piéce no.	Bezeichnung	Designation	Désignation	Bestell-Nr. Ref.-No. No.Ref.
A 1	Leiterplatte „MP-Netz"	Printed circuit board „MP-Mains"	Circuit imprimé „MP-Secteur"	UL 382-1B
A 2	Leiterplatte „CPU"	Printed circuit board „CPU"	Circuit imprimé „CPU"	UL 383-1B
A 3	Leiterplatte „Anzeige-Tastatur"	Printed circuit board „Indication-Keyboard"	Circuit imprimé „Affichage-Clavier"	UL 384-1
A 4	Leiterplatte „Analog-Ausgang"	Printed circuit board „Analog-Exit"	Circuit imprimé „Analogue-Sortie"	UL 385-1
A 5	Leiterplatte „Anzeige-Display"	Printed circuit board „Indication-Display"	Circuit imprimé „Affichage-Display"	EAO 091
B 1	Pt 100 Fühler Sicherheitskreis	Pt 100 Probe Safety circuit	Pt 100 Sonde Circuit securité	ETP 046 (US 060)
B 2	Pt 100 Fühler Regelung	Pt 100 Probe Controller	Pt 100 Sonde Réglage	ETP 046 (US 060)
B 3	Niveausensor	Level sensor	Niveau sensor	EKS 034
C 1	Motorkondensator	Motor condenser	Condensateur moteur	ECA 007
E 1	Heizkörper	Heater	Corps de chauffe	EH 148
F 1	Übertemperaturschutz (Umwälzpumpe)	Overtemperature protection (Circulating pump)	Protection de surpression (Pompe de circulation)	----------
M 1	Pumpenmotor	Pump motor	Moteur de pompe	EM 093
S 1	Netzschalter	Mains switch	Interrupteur secteur	EST 032
X 1	Netzanschluss / Netzkabel	Mains connection / Mains cable	Branchement secteur / Câble de secteur	EKN 008
X 8	Anschlussbuchse Kühlen	Connection socket Cooling	Douille de jonction réfroidissement	EQK 004
X 9	Anschlussbuchse Rücklaufsicherung	Connection socket Reflow security valve	Douille de jonction Protection de refoulement	EQD 037 + EQZ 006
X 22	Steckleiste 10pol.	Plug strip terminal	Réglette à fiches mâles	EZK 056
X 23	Steckleiste 8pol. (Magnetventil)	Plug strip terminal (Solenoid valve)	Réglette à fiches mâles (Vanne solenoide)	EZK 057

Geräteliste Schaltplan   **K 6 KP**   **gültig ab Serie X01**
List of parts Circuit diagram   **K 12 KP**   **at serial no.**
Liste de schéma connexions   **K 20 KP**   **à partir**
230V; 50Hz

Teil-Nr. Part No. Piéce no.	Bezeichnung	Designation	Désignation	K 6 KP K 20 KP Bestell-Nr. Ref.-No. No.Ref.	K 12 KP Bestell-Nr. Ref.-No. No.Ref.
A 1	Leiterplatte „MP-Netz"	Printed circuit board „MP-Mains"	Circuit imprimé „MP-Secteur"	UL 382-1B	UL 382-1B
A 2	Leiterplatte „CPU"	Printed circuit board „CPU"	Circuit imprimé „CPU"	UL 383-1B	UL 383-1B
A 3	Leiterplatte „Anzeige-Tastatur"	Printed circuit board „Indication-Keyboard"	Circuit imprimé „Affichage-Clavier"	UL 384-1	UL 384-1
A 4	Leiterplatte „Analog-Ausgang"	Printed circuit board „Analog-Exit"	Circuit imprimé „Analogue-Sortie"	UL 385-1	UL 385-1
A 5	Leiterplatte „Anzeige-Display"	Printed circuit board „Indication-Display"	Circuit imprimé „Affichage-Display"	EAO 091	EAO 091
B 1	Pt 100 Fühler Sicherheitskreis	Pt 100 Probe Safety circuit	Pt 100 Sonde Circuit securité	ETP 046 (US 060)	ETP 048 (US 061)
B 2	Pt 100 Fühler Regelung	Pt 100 Probe Controller	Pt 100 Sonde Réglage	ETP 046 (US 060)	ETP 048 (US 061)
B 3	Niveausensor	Level sensor	Niveau sensor	EKS 034	EKS 034
C 1	Motorkondensator	Motor condenser	Condensateur moteur	ECA 007	ECA 007
E 1	Heizkörper	Heater	Corps de chauffe	EH 150	EH 154
F 1	Übertemperaturschutz (Umwälzpumpe)	Overtemperature protection (Circulating pump)	Protection de surpression (Pompe de circulation)	----------	----------
M 1	Pumpenmotor	Pump motor	Moteur de pompe	EM 094	EM 096
S 1	Netzschalter	Mains switch	Interrupteur secteur	EST 032	EST 032
X 1	Netzanschluss / Netzkabel	Mains connection / Mains cable	Branchement secteur / Câble de secteur	EKN 008	EKN 008
X 8	Anschlussbuchse Kühlen	Connection socket Cooling	Douille de jonction réfroidissement	EQK 004	EQK 004
X 9	Anschlussbuchse Rücklaufsicherung	Connection socket Reflow security valve	Douille de jonction Protection de refoulement	EQD 037 + EQZ 006	EQD 037 + EQZ 006
X 22	Steckleiste 10pol.	Plug strip terminal	Réglette à fiches mâles	EZK 056	EZK 056
X 23	Steckleiste 8pol. (Magnetventil)	Plug strip terminal (Solenoid valve)	Réglette à fiches mâles (Vanne solenoide)	EZK 057	EZK 057

Geräteliste Schaltplan   **D 15 KP**   **DL 15 KP**   **gültig ab Serie X01**
List of parts Circuit diagram   **D 20 KP**   **DL 20 KP**   **at serial no.**
Liste de schéma connexions   **D 30 KP**   **à partir**
230V; 50Hz / 230V; 60Hz

Teil-Nr. Part No. Piéce no.	Bezeichnung	Designation	Désignation	Bestell-Nr. Ref.-No. No.Ref.
A 1	Leiterplatte „MP-Netz"	Printed circuit board „MP-Mains"	Circuit imprimé „MP-Secteur"	UL 382-1B
A 2	Leiterplatte „CPU"	Printed circuit board „CPU"	Circuit imprimé „CPU"	UL 383-1B
A 3	Leiterplatte „Anzeige-Tastatur"	Printed circuit board „Indication-Keyboard"	Circuit imprimé „Affichage-Clavier"	UL 384-1
A 4	Leiterplatte „Analog-Ausgang"	Printed circuit board „Analog-Exit"	Circuit imprimé „Analogue-Sortie"	UL 385-1
A 5	Leiterplatte „Anzeige-Display"	Printed circuit board „Indication-Display"	Circuit imprimé „Affichage-Display"	EAO 091
B 1	Pt 100 Fühler Sicherheitskreis	Pt 100 Probe Safety circuit	Pt 100 Sonde Circuit securité	ETP 048 (US 061)
B 2	Pt 100 Fühler Regelung	Pt 100 Probe Controller	Pt 100 Sonde Réglage	ETP 048 (US 061)
B 3	Niveausensor	Level sensor	Niveau sensor	EKS 034
C 1	Motorkondensator	Motor condenser	Condensateur moteur	ECA 007
E 1	Heizkörper	Heater	Corps de chauffe	EH 154
F 1	Übertemperaturschutz (Umwälzpumpe)	Overtemperature protection (Circulating pump)	Protection de surpression (Pompe de circulation)	----------
M 1	Pumpenmotor	Pump motor	Moteur de pompe	EM 096
S 1	Netzschalter	Mains switch	Interrupteur secteur	EST 032
X 1	Netzanschluss / Netzkabel	Mains connection / Mains cable	Branchement secteur / Câble de secteur	EKN 008
X 8	Anschlussbuchse Kühlen	Connection socket Cooling	Douille de jonction réfroidissement	EQK 004
X 9	Anschlussbuchse Rücklaufsicherung	Connection socket Reflow security valve	Douille de jonction Protection de refoulement	EQD 037 + EQZ 006

Notes for trouble-shooting for
LAUDA Thermostats with P - electronics

LAUDA

Each repair requiring the opening of the control part by means of tools and each work at the electronic part may only be done by a trained technician !

Malfunction	Fault	Reason	Remedy
Green signal lamp of mains switch not alight	Control fuse has actuated		Replace fuse on PCB "MP Mains" 5 x 20; F4A
		Overload on PCB	Replace PCB " MP Mains "
Display: "Level too low "	Bath level too low	Evaporation; external consuming device not refilled	Fill in bath liquid; press reset button twice
		Leakage in hose connections	Check hoses and their connection; if necessary replace them; fill in bath liquid; press reset button twice
	Level detector		Check level detector, plugs and hall sensors; if necessary replace them; check their function carefully

For USH 400(/6) fill in bath liquid up to the level mark |
Display: " Temperature too high "	Temperature probe	Temperature difference between two probes > 15°C	Replace bath temperature probe (double Pt 100). For USH 400(/6) please check both single Pt 100.
	Temperature of bath liquid above over-temperature switch-off point (To)	Overtemperature switch-off point (To) set too low	Press reset button; adjust overtemp. switch-off point (To) at an higher value; press reset button
		Triac or triggering	Replace triac or PCB "MP Mains"
Display: " External fault "	Contact input 14 N "Fault " is used	Pins ½ not connected	Reason for malfunction caused by external system
		No signal transmitter connected to socket 14 N, though selection at PAR level is activated	Switch off function " Contact input Fault " at PAR level; see operating instructions
Display: " Ts > To	Wrong inputs	Setpoint adjusted above overtemperature switch-off point (To)	Adjust overtemperature switch-off point (To) at an higher temperature; pay attention to bath liquid, flash point etc. !!
		Overtemperature switch-off point adjusted below setpoint (Ts)	First adjust setpoint (Ts) at a lower value then set requested overtemperature switch-off point
Display: "Ts < Tu"	Wrong input	Setpoint adjusted below low-temperature switch-off point (Tu)	Adjust low-temperature switch-off point (Tu) at a lower value
		Low-temperature switch-off point adjusted above setpoint (Ts)	First adjust setpoint at an higher temperature then set requested low-temperature switch-off point (Tu)

Malfunction	Fault	Reason	Remedy
Setpoint Ts is not adjustable but will disappear	Operating error	Setpoint is determined by the analogue input; see right side of display L2: A	Switch off analogue input
Sound signal appears when a button is pressed		Another function blocks the keybord e.g.: programme runs; RS 232 active; Parameter etc.	Leave the function or press ESC (RS 232) (R appears on the right side of display L2); Stop access and press the button "Local"
Display: "Tu – Cursor flashes" acoustic signal switches compressor off after 1 min.	Wrong input	Actual value is $\leq$ = Tu, resp. setpoint adjusted too close to low-temperature switch-off point Tu; bath temperature (Ti) falls below Tu	Set low-temperature switch-off point (Tu) at a lower value
Display "Out of range"	Wrong input	Tried to enter values being out of admissible ranges; Ts,To,Tu being out of operating temp.	Choose the right values taking into consideration their limitations; check bath liquid or configuration after having switched on the unit
		Programme input out of operating temperature range of the unit	Enter admissible values
		Value for Xp, Tn, Tv above 199,9	Enter admissible values
Tu or To is not adjustable; "Out of range "		Input values are outside of temperature limits of the type of unit or initialization does not fit to the type of unit	Reinitialize type of unit: (see operating instructions "Maintenance"); may also return *Default-values*
Display: "TA" (only for USH 400(/6)		Motor chamber temperature > 55 °C	Surrounding temperature of the part of the thermostat may be too high (see operating instructions 5.2.8)
Display: ↓ (only for USH 400(/6) RUL and RUK)		Level too low	Fill in bath liquid ; (see operating instructions 5.2.3)
Display: ↑ (only for USH 400(/6) RUL and RUK)		Level in the vessel is close to overflow; heater switches off	Either reduce the amount of thermal liquid or install an other vessel Attention: HOT !!!
Display: "Upper limitation of oil > limitation of unit" (cancelled beginning with software version 1.06)		Admissible working temperature range of bath liquid exceeds operating temperature range of the unit	Bath liquid is accepted, no other steps necessary; unit limitations valid
Setpoint cannot be selected by means of keyboard		Check setpoint selection; see right side of display L2; P=Programme; A=Analogue; R=RS 232	Switch setpoint selection to I=Internal
Display: "External fault – clock stop!"	Clock does not run	RAM defective	Unit has to be switched on once again; set date and time once again; see operating instructions if necessary replace RAM

Malfunction	Fault	Reason	Remedy
Display: "Internal Pt 100 defective"	Double Pt 100 for bath temperature or safety temperature	Interruption, short circuit or temperature deviation of bath temperature probes too important	Replace double Pt 100 for bath temperature For USH 400(/6) please check both single Pt 100
Display: "Ext. Pt 100 not connected"		Tried to switch over to external control without connecting an external Pt 100	Continue to work with internal control or connect external Pt 100 for T1 or T2; look at display for control variables I, 1 or 2; check display for T1 or T2
		Tried to calibrate Pt 100 being not connected	
Display: "Correcting value too high"	Important deviation of Pt 100 from standard values	Value input differing from the basic value that is indicated by more than 5 K	Check temperature reference thermometer, check Pt 100; replace PCB "CPU"
Scale of analogue outputs shows discrepancies		Outputs not correctly calibrated	Calibrate the analogue output channels (see operating instructions)
Unit does not heat though heating is indicated	Triac		Replace triac
	Heater	Defective	Replace heater
		Interruption	Eliminate
		Electronics	Replace PCB "MP Mains"
		Controller output limitation at PAR level too small	Enter higher values at PAR level (e.g. 100 %)
Pump does not run	Temperature safety cut-out in pump has actuated Pump stops	Motor blocked	Turn propeller of motor; if necessary replace it; clean pump
		Viscosity of bath liquid too high	Use other bath liquid; wait until motor has cooled down
Bath temperature rises clearly above adjusted setpoint (Ts) Heating indication ON		Controller	Replace PCB "MP Mains" or PCB " CPU "
Heating indication OFF		Triac	Replace triac
Temperature rises slowly above adjusted setpoint Heating indication OFF	Cooling not sufficient	Heat emission of pump	Connect cooling water supply or other kind of cooling
Display shows wrong temperature (Ti, T1, T2)		Temperature probe	Replace double Pt 100 or external Pt 100 T1, T2
Display is dark	Temperature cut-out in transformer has actuated	Overload caused by short – circuit	Replace PCBs or control unit

Malfunction	Fault	Reason	Remedy
Unit does not work at adjusted setpoint		Wrong control parameters adjusted	Enter new values or start autoadaption
Temperature control by means of external controller not stable		Thermal contact of bath liquid and external measuring point not sufficient	Improve circulation through external consuming device or thermal contact to ext. Pt 100
Unit does not cool down		Controller output limitation at PAR level too small	Adjust higher value at PAR level (e.g. -100 %)
	Compressor defective		Replace refrigeration unit – by refrigeration engineer !!
	Leakage in refrigeration system		Clear leakage, fill in refrigerant – by refrigeration engineer !!
	Compressor does not run	Compressor without tension	Eliminate line interruption
		Triggering defective	Replace PCB "MP Mains "
Unit does not cool down	Compressor does not run	Pressure switch has actuated	Unscrew grid, clean condenser, blow through compressed air, improve ventilation
	Solenoid valves do not work correctly	Triggering defective	Replace PCB " MP Mains "
Compressor switches ON and OFF in regular periods; temperature constancy very bad	Condensation pressure too high	Fan defective	Replace fan motor
		Fan speed (only RK)	Check speed or speed controller
	Condenser dirty	Dust	Unscrew grid, from the back side blow compressed air or nitrogen through condenser
		Ventilation disturbed	Enlarge distance to nearby units or walls
		Ambient temperature too high	Air the room
Insufficient cooling in the lower temperature range		Bath liquid contaminated by condensate	Replace bath liquid to suit bath temperature
	Cools down to approx. 0°C only	Bath liquid not suitable (water)	Use water/ glycol mixture

BESTÄTIGUNG / CONFIRMATION / CONFIRMATION

LAUDA

An / To / A:
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Von / From / De :

Firma / Company / Entreprise:

Straße / Street / Rue:

Ort / City / Ville:

Tel.:

Fax:

Betreiber / Responsible person / Personne responsable:

Hiermit bestätigen wir, daß nachfolgend aufgeführtes LAUDA-Gerät (Daten vom Typenschild):
We herewith confirm that the following LAUDA-equipment (see label):
Par la présente nous confirmons que l'appareil LAUDA (voir plaque signalétique):

Typ / Type / Type :	Serien-Nr. / Serial no. / No. de série:

mit folgendem Medium betrieben wurde
was used with the below mentioned media
a été utilisé avec le liquide suivant

Darüber hinaus bestätigen wir, daß das oben aufgeführte Gerät sorgfältig gereinigt wurde, die Anschlüsse verschlossen sind, und sich weder giftige, aggressive, radioaktive noch andere gefährliche Medien in dem Gerät befinden.

Additionally we confirm that the above mentioned equipment has been cleaned, that all connectors are closed and that there are no poisonous, aggressive, radioactive or other dangerous media inside the equipment.

D'autre part, nous confirmons que l'appareil mentionné ci-dessus a été nettoyé correctement, que les tubulures sont fermées et qu'il n'y a aucun produit toxique, agressif, radioactif ou autre produit nocif ou dangeureux dans la cuve.

Stempel Seal / Cachet.	Datum Date / Date	Betreiber Responsible person / Personne responsable